AN ABSTRACT OF THE DISSERTATION OF

Susan S. Levy for the degree of Doctor of Philosophy in Human Performance presented on August 2, 2001. Title: The Effect of a Mail-Mediated Intervention on Exercise Behavior

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Self-determination theory suggests that social contexts that promote a sense of autonomy, competence, and relatedness will increase internalization of behavioral regulation and lead to more self-determined forms of motivation, the prototype of which is intrinsic motivation. A positive relationship between internalization of exercise behavior regulation and actual levels of exercise has been supported in the exercise domain, however the manipulation of social contexts to elicit greater internalization of exercise behavior regulation has received little attention. The purpose of this study was to examine the effect of a mail-mediated intervention, designed to promote perceptions of autonomy, competence, and relatedness, on exercise behavior in adults. Additionally, this study examined the effect of a booster postcard that emphasized the main points of the initial intervention on the continuance of exercise behavior. Participants were 185 adults initially classified in the preparation stage of exercise behavior. Participants were randomly divided into intervention only (INT), intervention plus booster (INTB), and control (CONT) groups. Both intervention groups received a four-page intervention packet of printed materials, while the control group received an

American Heart Association physical activity and health facts packet of similar length. After 1 month, the INTB group received a booster postcard that emphasized the focal points of the initial intervention packet. All participants completed self-report measures of perceptions of autonomy, perceptions of competence, perceptions of relatedness, exercise behavior regulation, and exercise behavior at baseline, 1 month, and 2 months. One hundred twenty-six participants completed questionnaires at all three time periods.

A 3 (INT/INTB/CONT) X 2 (male/female) X 3 (baseline/1 month/2 months) repeated measures analysis of variance revealed that all three groups significantly increased exercise behavior over the 2-month period, however no significant interactions were detected. A 3 (INT/INTB/CONT) X 2 (male/female) X 3 (baseline/1 month/2 months) repeated measures multivariate analysis of variance conducted for perceptions of autonomy, competence, and relatedness, revealed no significant interactions. Structural equation modeling techniques used to examine the pattern of theoretical relationships among variables did not support the pattern of relationships suggested by self-determination theory, but rather suggested that perceptions of competence mediated the relationship between self-determined exercise motivation and exercise behavior.

# The Effect of a Mail-Mediated Intervention on Exercise Behavior

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

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Susan S. Levy, Author

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## DEDICATION

In memory of Richard Steven Levy

The Effect of a Mail-Mediated Intervention on Exercise Behavior

# INTRODUCTION

Despite the overwhelming evidence of the physiological and psychological health benefits of regular physical activity and exercise, too few Americans engage at levels sufficient to realize these benefits (U.S. Department of Health and Human Services [USDHHS], 2000). Indeed, over 250,000 deaths annually in the U.S. have been associated with physical inactivity alone (McGinnis & Foege, 1993). Moreover, the economic burden in terms of resultant health care costs is enormous (Kaman & Patton, 1994). Perhaps the greatest challenge, then, facing exercise psychologists and behavioral scientists lies in increasing the number of individuals who participate in physical activity on a regular basis.

Recent investigations suggest the importance of motivational factors in determining the adoption and maintenance of physical activity behaviors (Markland, 1999; Mullan & Markland, 1997). In particular, the influence of intrinsic and extrinsic motivation has been explored. Intrinsic motivation refers to performing an activity for the inherent pleasure and satisfaction of the activity itself. In contrast, extrinsic motivation refers to performing an activity for some outcome separable from the activity (Ryan & Deci, 2000a). That is, the activity holds some instrumental value. Historically, these two constructs have been viewed dichotomously, and the relationship of one or both to sport and exercise behaviors

has been examined from several theoretical perspectives, including competence motivation theory (Harter, 1981), self-efficacy theory (Bandura, 1986), and cognitive evaluation theory (Deci & Ryan, 1985a).

Cognitive evaluation theory (CET; Deci & Ryan, 1985a), a subtheory of self-determination theory (Deci & Ryan, 1985a), has received considerable attention in explaining social factors that influence intrinsic motivation in sport contexts. Higher levels of intrinsic motivation have been associated with contexts that are perceived as less controlling and provide greater perceptions of choice (Fortier, Vallerand, Briere, & Provencher, 1995), and events that provide information leading to positive perceptions of competence (Amorose & Horn, 2000).

A basic tenet of CET is that intrinsic motivation will only occur for those activities or behaviors that hold some type of inherent interest or appeal for the individual (Ryan & Deci, 2000a). Exercise, however, may be categorized by many as less than inherently interesting and appealing. It should, therefore, be no surprise that the adoption and maintenance of exercise behavior cannot fully be explained by focusing on intrinsic motivation alone. Thus, to explain exercise behavior, it may be more useful to understand the nature of extrinsic motivation.

Self-determination theory (SDT, Deci & Ryan, 1985a) proposes that extrinsic motivation is not a unitary concept, but rather, has different forms, each reflecting varying degrees of autonomy or self-determination. Autonomy refers to an internal locus of causality, or the feeling that one is the origin of one's actions,

rather than a feeling of being controlled (deCharms, 1968). Hence, individuals who engage in an activity for its instrumental value, may do so based on different levels of autonomy (Ryan & Deci, 2000a). SDT further suggests that individuals will move along a continuum of behavioral regulation, ranging from amotivation, representing no regulation of behavior, to intrinsic motivation, the prototype of self-determined regulation. Between these distal points on the continuum lie the different types of extrinsic motivation ranging from the least to the most autonomous, or self-determined, form. Movement along the continuum is associated with increasingly positive psychological and behavioral outcomes (Deci & Ryan, 1985b).

Amotivation sits at the far end of the continuum, and represents a lack of intention to act (Ryan & Deci, 2000b). That is, individuals will either not engage in an activity at all, or will do so with no sense of why they are engaging in the activity. Amotivation is then followed on the continuum by those states representing the various types of motivated behaviors. The least autonomous form of extrinsic motivation is represented by external regulation in which behaviors are performed due to a sense of external control or pressure. This state most closely represents the classic representation of extrinsic motivation, in which behaviors are performed to receive some type of reward, or to avoid sanctions (Ryan & Deci, 2000a). The next type of extrinsic motivation on the continuum is represented by introjected regulation. In this state, the individual has introjected, or internalized without endorsement, the external control. Thus, behavior is performed because

one feels one "should," and the individual experiences little sense of autonomy with regards to the behavior. A third and more self-determined type of extrinsic motivation is represented by identified regulation. The individual performs a behavior because he or she has identified the behavior as highly valuable and related to personal goals (Ryan & Deci, 2000b). The most self-determined form of extrinsic motivation is represented by integrated regulation. The individual has fully assimilated the identified regulation into the self, and the behavioral regulation is consistent with other needs and values (Ryan & Deci, 2000a). Finally, the prototype of self-determination is intrinsic motivation (Ryan & Deci, 2000b), which sits at the far end of the continuum. Behavior is engaged in for its inherent pleasure. Vallerand and colleagues (Vallerand et al., 1993) described three types of intrinsic motivation: intrinsic motivation to know, learn, or explore; to accomplish or master an activity; and to experience sensation or stimulation.

SDT proposes that social factors that promote a sense of autonomy, competence, and relatedness, three basic psychological needs, will facilitate movement along the continuum through increased internalization, assimilation, and integration of behavioral regulation (Ryan, 1995). Organismic integration theory (OIT, Deci & Ryan, 1985a; Ryan & Deci, 2000b), a second subtheory of SDT, describes this process of internalization and integration and helps explain how social contexts influence behavioral regulation. According to OIT, contexts that provide choice, minimize pressure to perform in certain ways, and encourage personal initiation of behavior will foster a sense of autonomy. Contexts in which

behavior-outcome contingencies are clear and informational feedback is provided will promote perceptions of competence. Finally, contexts that promote involvement and interest from significant others will promote a sense of relatedness (Deci & Ryan, 1991). Thus, when these three dimensions of the social context are optimized, individuals should be more able to satisfy the three basic psychological needs, leading to greater self-determined behavior. OIT further proposes that fostering a sense of autonomy is critical in the integration of regulation. For individuals to truly integrate regulations into their own system of values and goals they must do so with a sense of volition and freedom from pressure and control. The promotion of competence and relatedness in the absence of autonomy support may lead only to introjected motivation (Ryan & Deci, 2000b).

The theoretical relationships among psychological needs, internalization of behavioral regulation, and behavioral and psychological outcomes proposed by SDT have been supported in educational contexts (Black & Deci, 2000; Miserandino, 1996), health-care settings (Kasser & Ryan, 1999; O'Connor & Vallerand, 1994a), and in treatment for chemical dependency (Foote et al., 1999). Several studies particularly attest to the utility of SDT in explaining and predicting behaviors in each of these contexts.

For example, individuals in a weight-loss program who reported more self-determined program behavior regulation, attended the program more regularly, lost more weight, and maintained their weight loss to a greater degree than those with less autonomous reasons for attending the program (Williams, Grow, Freedman,

Ryan, & Deci, 1996). Perceptions of physicians' autonomy support influenced adherence to long-term medication regimens in adult outpatients (Williams, Rodin, Ryan, Grolnick, & Deci, 1998). Moreover, the patients' self-determined motivation mediated the relationship between perceptions of autonomy support and adherence.

A model of academic motivation has been explored in which the behavior of teachers, parents, and school administrators influenced high school students' perceptions of competence and autonomy, which, in turn, led to behavior (Vallerand, Fortier, & Guay, 1997). Specifically, the less autonomy supportive the behavior of teachers, parents, and administrators, the lower students' perceptions of competence and autonomy. Low levels of perceived competence and autonomy led to less self-determined academic motivation, which led to greater intention to drop out of high school, and ultimately to actual dropout. Vallerand (1997) has presented and discussed these relationships from a hierarchical perspective wherein social factors influence psychological factors (i.e., perceptions of autonomy, perceptions of competence, and perceptions of relatedness), which lead to levels of self-determined motivation, which then lead to affective and behavioral consequences. Support for this pattern of relationships has been reported in sport (Vallerand & Losier, 1999).

Research further attests to the viability of social context manipulation, and supports the theoretical relationships suggested by SDT. Students exposed to teachers trained to instruct in a controlling manner performed more poorly on problem-solving tasks than students exposed to non-controlling teachers

(Boggiano, Flink, Shields, Seelbach, & Barrett, 1993; Flink, Boggiano, & Barrett, 1990). In a laboratory setting, Deci, Eghrari, Patrick, and Leone (1994) found that internalization of behavioral regulation of an uninteresting computer tracking task was facilitated by providing autonomy supportive instructions and cues.

The relationships suggested by SDT have also been examined in exercise contexts, with greater levels of internalization associated with greater frequency of exercise (Li, 1999) as well as adoption and persistence (Ingledew, Markland, & Medley, 1998; Mullan & Markland, 1997). More self-determined motives for participation in exercise have also been associated with greater adherence (Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997) and greater levels of intrinsic motivation (Markland, 1999). While the theoretical relationships proposed by SDT have been supported in the exercise domain, it remains unclear whether social contexts can be successfully manipulated, and if these manipulations will lead to positive outcomes, such as increased exercise behaviors.

In the exercise domain, the *potential* for manipulation of autonomy support in social contexts has been explored with regard to choice of music in aerobic workout tapes (Dwyer, 1995). Individuals who believed their choice of music was used in an aerobic videotape to which they worked out for 25 minutes reported significantly greater interest/enjoyment, perceived competence, effort/importance, and total intrinsic motivation than those who did not believe their music choices were considered. Additionally, those in the choice group reported significantly greater perceptions of choice than those in the control group. These findings

provide support for the relationship between autonomy support and intrinsic motivation, and strengthen the supposition that context may be associated to perceptions of autonomy support. However, as no measures of intrinsic motivation or perceptions of choice were administered at baseline, the direction of the relationships is unclear. The study does suggest, however, the potential for successful intervention and manipulation of contextual factors in the exercise domain.

Interventions in the exercise domain have demonstrated varying degrees of success (Sallis & Owen, 1999). Dishman and Buckworth (1996) conducted a meta-analysis of 127 physical activity interventions and found that the greatest effect size (i.e., .92) resulted from interventions using some type of behavior modification. Furthermore, and perhaps surprisingly, mediated interventions (i.e., mail, mass-media, or telephone based) had a greater effect size than face-to-face or some combination of face-to-face and mediated interventions. Mail-mediated interventions have been successful in increasing exercise behavior in female clerical workers (Cardinal & Sachs, 1996) and community worksite employees (Marcus, Banspach, et al., 1992). Cardinal and Sachs (1996), in a randomized control study, significantly increased exercise behaviors after 31 days in participants who received a lifestyle exercise behavior packet of printed materials in the mail. Marcus and colleagues (1992), in a pre-experimental study, reported similar exercise behavior increases six weeks after mailing written materials to community participants. In a prospective, randomized trial a tailored mail-mediated

intervention positively influenced movement in stage of exercise behavior over a 3-month period when compared to mailed standard self-help materials (Marcus, Emmons, et al., 1998). Mail-mediated interventions have also been successful in maintaining physical activity increases at 6 months post-intervention (Bock, Marcus, Pinto, & Forsyth, 2001). Finally, mail-mediated interventions in conjunction with follow-up telephone contact have been used in exercise promotion (e.g., Chen et al., 1998).

Together, literature from the academic, health-care, and physical domain support the theoretical relationships proposed by SDT. Moreover, research in the academic and health-care domains has demonstrated the successful manipulation of social contexts that lead to positive behavioral and psychological outcomes. While the theoretical relationships proposed by SDT have been supported in the exercise domain, it remains unclear whether social contexts can be successfully manipulated, and if these manipulations will lead to positive outcomes, such as increased exercise behaviors. Findings from studies employing mail-mediated interventions suggest the viability of this approach for increasing exercise behavior.

## GOALS AND HYPOTHESES

Therefore, the purpose of this study was to test the effectiveness of a mail-mediated intervention based on the theoretical relationships proposed by SDT in increasing exercise behavior and psychosocial outcomes in community-dwelling, healthy adults. Specifically, the study had four main goals. The first was to evaluate the effect of a theoretically based mail-mediated intervention on increasing exercise behavior in adults after 1 month. It was hypothesized that adults exposed to the theoretically based mail-mediated intervention would evidence significantly greater increases in exercise behavior after 1 month than adults not exposed to the intervention. As the literature suggests that exercise behavior levels differ for males and females (Sallis & Owen, 1999), and that males and females report different levels of exercise motivation (Li, 1999), gender differences were examined with regards to the influence of the intervention on exercise behavior. Additionally, as exercise behavior decreases with age (USDHHS, 2000), age was examined separately as a factor influencing the effects of the intervention on exercise behavior.

A second goal of the current study was to evaluate the effect of an additional mail-mediated booster, in the form of a postcard, delivered after the initial 1-month intervention period on continuance of exercise behavior at 2 months in adults exposed to the initial mail-mediated intervention. The postcard reiterated the theoretical focal points of the initial intervention packet. It was hypothesized

that intervention adults who received the additional mail-mediated booster at 1 month would evidence significantly greater exercise involvement at 2 months than those intervention adults who did not receive the additional booster and those adults in the control group.

A third goal of the current study was to examine the effect of the intervention on those variables suggested to mediate the relationship between the intervention and exercise behaviors. These included perceptions of autonomy, competence, and relatedness. This goal addressed recent recommendations for critically assessing the influence of interventions on the theoretically proposed mechanisms of change (see Baranowski, Anderson, & Carmack, 1998; Sallis, 2001). It was hypothesized that those in the intervention groups would evidence significantly greater increases in these mediating variables than those in the control group after 1 month. It was also hypothesized that intervention adults who received the additional mail-mediated booster at 1 month would evidence significantly greater increases in these mediating variables at 2 months than those intervention adults who did not receive the additional booster and adults in the control group.

Finally, the sequencing of relationships among the intervention mediating variables and exercise behavior were examined in order to clarify the pattern of relationships suggested by self-determination theory. Specifically, two models were explored. In the first, perceptions of autonomy, competence, and relatedness influenced self-determined motivation, which, in turn influenced exercise behavior. This hierarchical model, suggested by Vallerand and colleagues (Vallerand, 1997;

Vallerand et al., 1999) and couched in self-determination theory, has been supported in the academic (Fortier, Vallerand, & Guay, 1995) and sport domains (Vallerand et al., 1999). A second pattern of relationships, suggested by the diathesis-stress model of achievement processes (Boggiano, 1998), was also examined. In this model, perceptions of autonomy and relatedness influenced self-determined motivation, which in turn influenced perceptions of competence, which then influenced exercise behavior. This sequencing in which perceived competence is an outcome rather than an antecedent of self-determined motivation has recently been supported with regard to changes in perceived academic competence (Guay, Boggiano, & Vallerand, 2001) and patients' adherence to diabetes medication regimens (Williams, Freedman, & Deci, 1998). It was hypothesized that the model suggested by self-determination theory would provide a better fit to the observed data and provide a better explanation of exercise behavior in this sample than the alternative model.

Thus, this study contributed to the literature by first examining the efficacy of an intervention based on self-determination theory, using a delivery method that is relatively low cost and may potentially be applied to large populations (Sallis, 2001). Second, this study examined the influence of the intervention on the theoretically proposed mediators of intervention effects on exercise outcomes. Meeting this objective addressed an important and often neglected goal of physical

activity and exercise intervention research (see Baronowski, Anderson, & Carmack, 1998; Sallis, 2001). Finally, this study contributed to the understanding of the pattern of relationships of the theoretical variables proposed to influence exercise behavior.

# METHOD

## Participants

Participants were 185 females (n=126) and males (n=59) from two communities, one in the Pacific Northwest (78%) and one in the Northeast (22%), of similar demographic makeup, ranging in age from 22 to 79 years (M=46.8, SD=12.8). Individuals volunteered for participation after reading study announcements in community church newsletters, newspaper advertisements, and at local supermarkets. Churches were specifically targeted for sampling as the Centers for Disease Control has advocated this strategy in the promotion of health and physical activity behaviors (UDDHHS, 1996). Several studies (e.g., Davis et al., 1994; Voorhees et al., 1996) attest to the efficacy of this approach in making inroads into communities with regard to health promotion efforts. The majority of the participants (80.5%) were married or living with a partner, worked outside of the home (70.6%) at a full-time job (62.4%), and reported an income level over $40K per year (70.6%). Study participants were predominantly Caucasian (94.1%).

Individuals who volunteered for participation were eligible for inclusion if they were not currently exercising on a regular basis, yet, had taken some preparatory steps towards exercising regularly (i.e., where regular exercise was defined as 3 or more times a week for periods of 30 min or longer). This definition corresponds to the preparation stage of exercise behavior as described in the

transtheoretical model (Prochaska & Marcus, 1994). This criterion for inclusion was chosen to align with the body of literature suggesting the soundness of tailoring interventions to individuals' stage of readiness to change (e.g., Cardinal & Sachs, 1996; Dunn et al., 1999; Marcus et al., 1992). This particular stage was chosen as a target, in that individuals who are in preparation demonstrate intention for the behavior, yet are less likely to be highly self-determined in the regulation of exercise behavior (Mullan & Markland, 1997). These individuals, being at the lower levels of exercise behavior regulation, had the greatest chance of evidencing change over the intervention period. Additionally, potential participants completed the Physical Activity Readiness Questionnaire (PAR-Q; Canadian Society for Exercise Physiology, 1994) to ensure that current health status and health history did not preclude participation in physical activity, and thus, exclusion from study participation. As an incentive, participants who completed and returned measures at Time 1 and Time 2 had their names entered into a drawing for a $50 cash prize, at each time period. Additionally, participants who completed and returned measures at all three data collection periods had their names entered into a drawing for a $250 cash prize.

## Measures

The importance of clearly defining the construct in question is critical in any research study. Patterson (2000) recently emphasized this notion in the area of

physical activity. The intervention used in this study encouraged individuals to choose the types of exercise behaviors in which they would like to participate, including less structured behaviors, such as garden work, which are more typically considered physical activity. Therefore, the measures used in this study included a consistent definition, in the directions, of exercise as inclusive of "structured or unstructured physical activity, such as running, walking, sports, garden or yard work, and heavy housecleaning" (see Appendix D). This strategy was adopted to ensure that all participants interpreted the term in the same manner when responding to questionnaire items.

## Screening Measures

Stage of Exercise. The stage of exercise behavior algorithm (Reed, Velicer, Prochaska, Rossi, & Marcus, 1997) was verbally administered to potential participants upon contact with the investigator, in order to determine eligibility for participation in the study. The staging algorithm asks respondents to choose one of five statements describing their current level of regular exercise behavior, defined as "equal to three or more days per week." Those who chose the statement: "I am planning to start in the next 30 days," representing the preparation stage of exercise, were invited to participate in the study. Cardinal (1995a, 1995b) reported perfect ($r = 1.00$) three-day test-retest reliability for the scale in two samples, and concurrent validity with measures of $VO_{2max}$ and body mass index.

Readiness for physical activity. Readiness for physical activity was assessed using the Physical Activity for Readiness Questionnaire (PAR-Q, Canadian Society for Exercise Physiology, 1994). The questionnaire consists of seven questions regarding health history and current health status, to which respondents answer "yes" or "no." A "yes" response to any question on the measure indicates that participation in physical activity may be contraindicated, and excluded the respondent from participation in the study without permission from a physician. Administration of the measure has been recommended as a pre-participation screening tool prior to initiating a physical activity program (American College of Sports Medicine, 2000).

## Process Measures

Perceptions of autonomy. Perceptions of autonomy in exercise were assessed using the Locus of Causality for Exercise Scale (Markland & Hardy, 1997), which assesses the extent to which respondents feel they choose to exercise rather than feeling that they have to exercise. The measure is a 3-item Likert-type scale with responses ranging from 1 = strongly disagree to 6 = strongly agree. Markland and Hardy reported concurrent validity for the measure and alpha reliability coefficients of .82 and .83 in two adult samples. Markland (1999) used the measure with female adult exercisers and reported an alpha reliability coefficient of .87.

Perceptions of competence. Perceptions of competence in exercise were assessed using the sports competence subscale of the Physical Self-Perception Profile (Fox, 1990) modified for exercise. The original subscale was modified by changing the word "sport" in each item to "exercise." The subscale consists of six items in an alternative choice response format. For each item, respondents first select which of two statements best describes them, and then whether the statement is "really true for me" or "sort of true for me." Scores range from 1 to 4 on the measure, with 4 representing higher levels of perceived competence. The scale developer reported acceptable factorial and discriminant validity, an internal consistency of $\alpha = .87$, and a 23-day test-retest reliability coefficient of .88 for the subscale. Li (1999) adapted the measure for exercise, and reported adequate reliability for the modified measure ($\alpha = .87$) once two items that had low correlations with the remaining four items were removed. For the current study, a 6-item modified scale was used, as internal consistencies were acceptable with all items retained.

Perceptions of relatedness. Perceptions of relatedness were assessed using the Social Support for Exercise Questionnaire (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). The 24-item measure consists of two subscales assessing social support for exercise provided by family and friends. Individuals respond to statements such as, "I have a friend or acquaintance who encouraged me to exercise," on a 5-point Likert-type scale ranging from 1 = never to 5 = very often.

The scale has established factorial and criterion-related validity, as well as acceptable internal consistency, with alpha coefficients ranging from $\alpha = .84$ (friends) to $\alpha = .91$ (family) (Sallis et al., 1987).

Exercise behavior regulation. Exercise behavior regulation was assessed using the Exercise Motivation Scale (Li, 1999). This 31-item measure consists of eight subscales representing the regulatory processes referenced in the OIT taxonomy (Ryan & Deci, 2000b): amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, intrinsic motivation to learn, intrinsic motivation to accomplish, and intrinsic motivation to experience sensation. The original scale was modified by changing the stem to refer to "exercise activity" rather than "this activity." The scale uses a Likert-type format in which individuals indicate the extent to which they agree with statements as to why they engage in exercise behavior ranging from 1 = strongly disagree to 6 = strongly agree. The measure has established factorial validity and acceptable internal consistency reliability, with alpha coefficients ranging from .71 to .85 (Li, 1999).

## Outcome Measures

Exercise behavior was assessed using two self-report measures. Recent reviews suggest that multiple assessments of physical activity will yield a more accurate profile of physical activity behavior (Wood, 2000). Additionally, two

measures of exercise behavior provided the preferred multiple indicators of the latent construct for the structural equation modeling analysis (MacCallum, 1995). The Leisure-Time Exercise Questionnaire (LTEQ, Godin & Shephard, 1985) was used to assess habitual weekly exercise behavior. This measure was used as the outcome exercise behavior measure in the evaluation of intervention effects as the construct and predictive validity of the instrument have been adequately demonstrated (see Kriska & Casperson, 1997). Respondents were asked to report the frequency with which they engaged in strenuous, moderate, and mild levels of physical activity during a typical week for periods of 15 min or longer. A composite exercise behavior score was calculated by weighting each frequency score as recommended by the authors of the scale (i.e., [strenuous X 9] + [moderate X 5] + [mild X 3]). Godin and Shephard (1985) reported a two-week test-retest reliability of .74. Additionally, using discriminant function analysis, the authors were able to correctly classify 69% of fit and 66% of unfit individuals in terms of $VO_{2max}$ and body fat percentage.

The Seven-day Physical Activity Recall Questionnaire (Blair, 1984) was also used to assess exercise behavior. The original measure was modified to refer to exercise activity by replacing the word "physical" with "exercise." The measure required the respondent to report how many hours in the past seven days he/she spent in vigorous and moderate activity. As with the LTEQ, a composite index score was calculated as recommended by Blair. The score was based on the vigorous and moderate scores as well as a light activity score computed based on

subtracting sleep (i.e., 8 hours), vigorous, and moderate hours from a 168-hour (i.e., one week) period. This questionnaire was chosen for two reasons. First, it assessed a similar time period (one week) as the LTEQ, and thus, correlations with the LTEQ should be higher than with measures assessing a different time frame (Jacobs, Ainsworth, Hartman, & Leon, 1993). Second, due to its short length, the burden of completion was relatively small. The measure has established concurrent validity with measures of $VO_{2max}$ and body fatness (Blair).

Process Evaluation

At the final questionnaire administration, the extent to which the intervention was implemented as intended was assessed. Participants were asked to report, by circling applicable responses, whether they had received the packet that was mailed to them, whether they had read the packet, and in the case of those in the intervention groups, whether they had completed intervention packet worksheets. Those in the booster intervention group were also asked to report whether they had received and read the booster postcard. Process evaluations have been included in health promotion planning models and provide critical information useful in interpreting the effects of an intervention more completely (Gielen & McDonald, 1997).

## Procedures

Permission to access members of church congregations was gained from 13 community church pastors and ministers. Potential participants were recruited through church newsletters, posted flyers, and announcements at church and religious group meetings. Community members were also solicited for participation through newspaper advertisements and at local supermarkets. A brief description of the study including inclusion criteria appeared with a phone number and e-mail address with which interested individuals contacted the investigator. Upon contact with the investigator, individuals were asked to answer a one-item question assessing their current level of exercise activity, and the PAR-Q was verbally administered. Those who were categorized in the preparation stage of exercise behavior and for whom physical activity was not contraindicated, as described above, were invited to participate in the study. Addresses for mailing study materials were obtained from participants.

Participants were mailed a packet containing an informed consent document that aligned with the Oregon State University Institutional Review Board guidelines for human subjects as well as questionnaires assessing perceptions of autonomy, competence, relatedness, exercise behavior regulation, and exercise behavior. Demographic information, including age, gender, marital and employment status, income, and ethnicity, was collected from participants in order

to adequately describe the sample. Participants were asked to sign the informed consent document, complete the baseline measures, and return the materials within 7 days in a self-addressed stamped envelope that was provided in the mailing. If materials were not returned within this time frame, participants were prompted to do so via a telephone call from the investigator.

Participants were randomly assigned to an intervention only (INT), intervention plus booster (INTB), or control group (CONT). Randomization of participants was blocked by number of household members participating in the study to ensure fidelity of treatment. After returning baseline questionnaires, those in the intervention groups were mailed the intervention packet described below, while those in the control group were mailed an informational packet containing American Heart Association (AHA) exercise and health facts adapted from an AHA website (www.americanheart.org, 1999; see Appendix C). In this way, all participants received a mailing, and the intervention was compared to what may be considered conventional treatment. This strategy of providing conventional treatment to controls is advocated in the design and implementation of health promotion interventions (Wagner & Guild, 1989). The investigator reviewed the informational packet to ensure that it contained only factual data and no SDT-relevant strategies (see Appendix F). After 1 month, all participants were mailed and asked to complete the same set of questionnaires completed at baseline. After returning the second set of questionnaires, the INTB group was mailed the booster

postcard reiterating the main points of the original intervention packet. All study participants were mailed and asked to complete all measures again after 2 months.

The intervention consisted of a four-page packet of printed materials (see Appendix A). The packet was designed to increase internalization of exercise behavior regulation, and was based on the tenets of OIT / SDT. It consisted of behavioral and cognitive strategies designed to foster a sense of autonomy, competence, and relatedness with regard to exercise behavior. SDT suggests that autonomy support is fostered in contexts that provide a sense of choice, rather than control, promote initiation of behavior, provide empathy and acknowledgement of feelings towards the behavior, and provide a rationale to increase the meaningfulness of the behavior (Deci et al., 1994). For example, the packet encouraged the participant to make choices about exercise and physical activity types, acknowledged the challenge of fitting physical activity and exercise into one's schedule, and asked the participant to think about reasons why they decided to exercise. Additionally, the intervention promoted goal-setting to increase competence, and encouraged seeking the support of others to increase a sense of relatedness.

The intervention packet was assessed for content validity and acceptability in three phases (see Appendix E). First, evaluative input was solicited from five experts in the area of self-determination theory. Three individuals responded, and completed evaluation forms regarding content and presentation of the packet. The experts assessed the extent to which the intervention packet addressed the SDT-

relevant contextual factors of autonomy, competence, and relatedness. Second, two fitness professionals evaluated the packet for appropriateness and acceptability. These individuals completed evaluation forms assessing the degree to which the packet was clear, appropriate for the intended sample, and presented in an inoffensive manner. Finally, the intervention packet was distributed to 24 individuals enrolled in a fitness walking class, who completed the same evaluation forms as the fitness professionals. Comments were used to modify the final intervention packet.

The booster postcard (see Appendix B) consisted of five messages highlighting the focal points of the main intervention packet. The postcard was designed to re-emphasize the strategies presented in the original intervention packet in a brief format. For example, the postcard included the statement; "Slip-ups are OK. Increasing physical activity is sometimes hard work!"

## Data Analyses

To evaluate Hypotheses One and Two, regarding the effect of the intervention packet (INT) and the intervention packet plus booster postcard (INTB) on exercise behavior, data were analyzed using a 3 (INT/INTB/control) X 2 (male/female) X 3 (baseline/1 month/2 months) repeated measures analysis of variance to detect significant main and interaction effects on the dependent variable of exercise behavior. A 3 (INT/INTB/control) X 3 (youngest/middle/oldest) X 3

(baseline/1 month/2 months) repeated measures analysis of variance was also conducted. Power calculations indicated that the final sample size of 126 participants would allow detection of a moderate effect size (.40) with a power of .50 at an alpha level of $p = .03$ (Park & Schutz, 1999).

To address Hypothesis Three, data were analyzed using a 3 (INT/INTB/control) X 2 (male/female) X 3 (baseline/1 month/2 months) repeated measures multivariate analysis of variance to detect significant main and interaction effects on the dependent variables of perceived autonomy, competence, and relatedness. A 3 (INT/INTB/control) X 3 (youngest/middle/oldest) X 3 (baseline/1 month/2 months) repeated measures multivariate analysis of variance to detect significant main and interaction effects on the dependent variables of perceived autonomy, competence, and relatedness was also conducted.

Structural equation modeling techniques using maximum likelihood estimation methods were used to examine the pattern of relationships among the variables of perceptions of autonomy, competence, relatedness, and level of self-determined motivation, and exercise behavior. Thus, a model (Model A) was specified in which perceptions of autonomy, competence, and relatedness influenced self-determined motivation, which then influenced exercise behavior (see Figure 1). In addition to this model, suggested by SDT and Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation, an alternative model was also tested. The specification, a priori, of competing models is useful in evaluating the proposed relationships and fit of each model to the sample data (MacCallum,

1995). Within the alternative model (Model B), reflecting the diathesis-stress model (Boggiano, 1998), self-determined motivation influenced exercise behavior via perceptions of competence (see Figure 2).

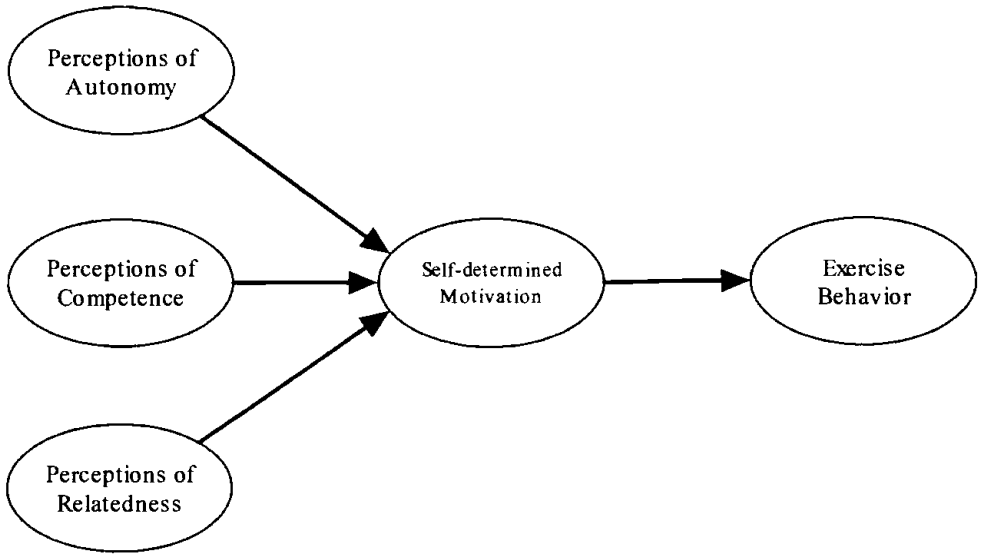


Figure 1. Model A

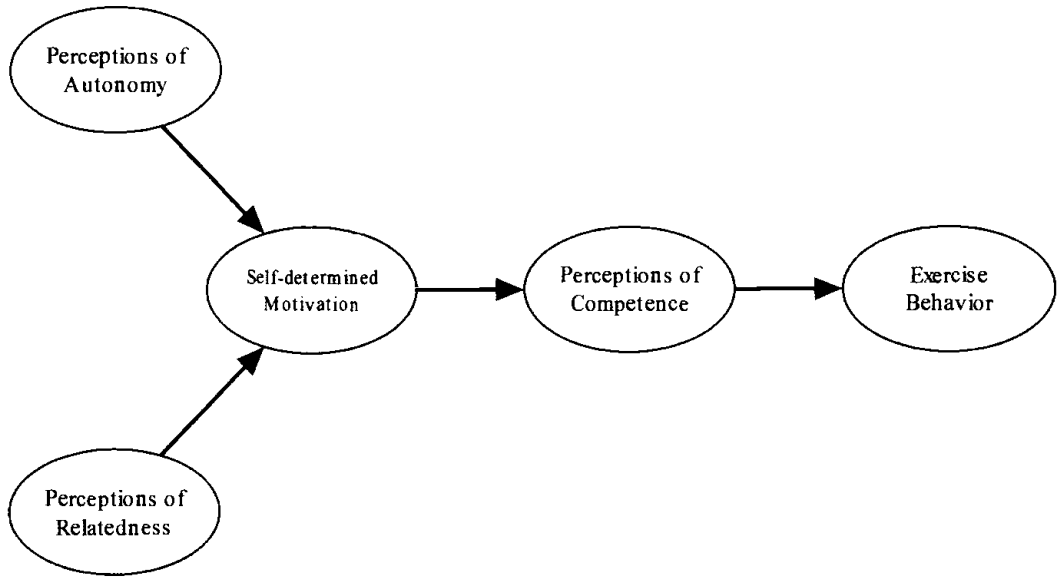


Figure 2. Model B

# RESULTS

## Preliminary Analyses

One hundred eighty-five participants completed questionnaires at baseline. Initial data screening revealed the distribution of the data was generally normal. Absolute skewness and kurtosis values ranged from .10 to 1.20 ($M$ = .43, $SD$ = .30) and .01 to 1.31 ($M$ = .38, $SD$ = .31), respectively. An analysis of variance revealed no significant baseline differences between participants from the Pacific Northwest community and the Northeast community in exercise behavior ($p > .05$). Similarly, a multivariate analysis of variance revealed no significant baseline differences between participants from the two communities in perceptions of autonomy, competence, and relatedness ($p > .05$). Baseline means, standard deviations, skewness, and kurtosis values are shown in Table 1.

In general, the sample reported moderate perceptions of autonomy, competence, and relatedness for exercise behavior at baseline. Mean values for perceptions of autonomy were basically at the scale midrange (scale range, 1 to 6), while mean values for perceptions of competence were just above midrange (scale range, 1 to 4). Mean values for perceptions of relatedness were below midrange (scale range, 1 to 5). Higher levels of perceptions of autonomy and competence than reported in this sample have been reported in regular exercisers (e.g., Markland, 1999). From a self-determination theoretical perspective, this might be

expected in individuals who are attempting to become regular exercisers, but have not yet achieved this status. Participants reported relatively low levels of amotivation (scale range, 1 to 6), as might also be expected from individuals who have expressed a desire to start a regular exercise program. Reported external regulation was below the subscale midpoint (scale range, 1 to 6), while scores on the remaining subscales were above the midpoint (scale ranges, 1 to 6). Participants reported the highest levels of identified regulation followed by intrinsic motivation to sensate and integrated regulation. A similar pattern of exercise behavior regulation has been reported in a similarly aged sample of individuals in the preparation stage (Mullen & Markland, 1997). Participants also reported exercise behavior levels that were similar to those reported elsewhere by individuals in the preparation stage (e.g., Cardinal, 1995a), further attesting to the fact that the current sample represented individuals in the preparation stage.

Internal Consistencies

Cronbach (1951) alpha coefficients were calculated to examine the internal consistency reliability of the measures used in the study and are shown in Table 1. Alpha coefficients for perceptions of autonomy, competence, relatedness, and behavioral regulation ranged from .68 (introjected regulation) to .92 (perceptions of relatedness, IM to know), indicating moderate to strong internal consistencies (Nunnally, 1978).

Table 1. Means, Standard Deviations, Skewness, Kurtosis, and Reliabilities (α)

| Variable | Mean | SD | Skewness | Kurtosis | α |
|---|---|---|---|---|---|
| Perceptions of Autonomy | 3.04 | 1.13 | .46 | -.44 | .80 |
| Perceptions of Competence | 2.21 | .60 | .15 | -.30 | .87 |
| Perceptions of Relatedness | 2.24 | .64 | .16 | -.44 | .92 |
| Amotivation | 1.85 | .89 | 1.20 | 1.31 | .85 |
| External Regulation | 2.74 | 1.10 | .40 | -.33 | .86 |
| Introjected Regulation | 3.75 | .96 | -.28 | .08 | .68 |
| Identified Regulation | 4.84 | .78 | -.68 | .46 | .79 |
| Integrated Regulation | 4.12 | .92 | -.28 | -.09 | .81 |
| IM to know | 3.31 | 1.15 | .10 | -.48 | .92 |
| IM to accomplish | 3.95 | .95 | -.35 | .15 | .80 |
| IM to sensate | 4.15 | 1.12 | -.48 | -.01 | .89 |
| Exercise Behavior (LTEQ) | 17.90 | 12.27 | .83 | .48 | -.16 |

Note: SD = standard deviation.

Patterson (2000) recently advocated reporting internal consistency reliabilities for self-report measures of physical activity. The LTEQ exercise behavior measure yielded an alpha coefficient of -.16. Low internal consistency for this measure may have been due to one or several factors, including a limited number of items on the measure and the use of a homogeneous sample (see Baumgartner, 1989). The sample for this study was purposefully homogeneous in that it was limited to a group in one stage of exercise behavior. While internal consistency was low, confirmatory factor analysis conducted using structural equation modeling revealed a relatively low level of error (.19) associated with this measure of exercise behavior.

Self-determination Continuum

As self-determination theory suggests that motivation lies on a continuum reflecting increasing degrees of self-determined behavioral regulation, an implicit assumption of the theory is that those forms of motivation adjacent on the continuum will be more positively correlated than non-adjacent forms of motivation. Meeting this assumption is a prerequisite to any further inferences made based on the theory. Thus, intercorrelations of the Exercise Motivation Scale subscales were examined in order to confirm a simplex pattern of relationships. The three forms of intrinsic motivation fall at the same point on the continuum and therefore, were averaged. As shown in Table 2, the subscales adjacent on the continuum were more positively correlated than non-adjacent subscales, supporting the existence of a continuum of motivation.

Table 2. Exercise Behavior Regulation Intercorrelations

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Amotivation | 1.00 | | | | | |
| External | .43 | 1.00 | | | | |
| Introjected | .10 | .40 | 1.00 | | | |
| Identified | -.43 | -.12 | .37 | 1.00 | | |
| Integrated | -.36 | -.18 | .29 | .74 | 1.00 | |
| Intrinsic | -.21 | -.08 | .06 | .52 | .67 | 1.00 |

## Main Analyses

### Hypotheses One and Two

It was hypothesized that adults in the intervention-only (INT) and intervention- plus-booster (INTB) groups would exhibit significantly greater increases in exercise behavior after 1 month than adults in the control (CONT) group. It was further hypothesized that adults in the INTB group would demonstrate significantly greater exercise levels at 2 months than adults in the INT and CONT groups.

Of the 185 participants who completed baseline questionnaires, 158 (85%) completed and returned questionnaires at 1 month, and 126 (68%) returned questionnaires at 2 months. Therefore, the main analyses were conducted using data collected from 126 participants. Alpha levels for tests of significance were adjusted using the Bonferroni adjustment ($\alpha / 2$) to account for the two repeated measures analyses that were conducted. Therefore, alpha was set to .03 for these analyses.

A 3 (INT/INTB/CONT) X 2 (male/female) X 3 (baseline/1 month/2 months) repeated measures analysis of variance was conducted to explore interaction and main effects for the dependent variable of exercise behavior. A significant main effect for time was revealed, $F(2, 119) = 10.72$, $p < .001$, $\eta^2 = .15$. No significant group or gender main effects or significant interactions were found.

Follow-up paired t-tests revealed that there were significant differences in exercise behavior from Time 1 ($M$ = 18.18, $SD$ = 12.20) to Time 2 ($M$ = 26.05, $SD$ = 16.60), $t$ (125) = 5.58, $p < .001$ and from Time 1 to Time 3 ($M$ = 27.00, $SD$ = 17.24), $t$ (125) = 5.65, $p < .001$, but no significant differences from Time 2 to Time 3 ($p > .05$). This finding suggests that all participants realized significant increases in exercise behavior after 1 month, and that exercise levels at 2 months were significantly greater than at baseline. However, no significant increases in exercise behavior occurred from 1 month to 2 months. Descriptive statistics for the three groups across time are shown in Table 3.

Table 3. Means and Standard Deviations for Exercise Behavior Over Time (Group - Gender)

| | Males | | Females | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| **INT** | $n$ = 13 | | $n$ = 30 | |
| T1 | 19.23 | 12.60 | 16.20 | 8.32 |
| T2 | 27.62 | 13.18 | 29.23 | 16.85 |
| T3 | 32.31 | 16.42 | 26.13 | 15.80 |
| **INTB** | $n$ = 16 | | $n$ = 29 | |
| T1 | 21.38 | 13.22 | 19.21 | 13.11 |
| T2 | 24.69 | 15.01 | 25.76 | 18.40 |
| T3 | 24.56 | 18.69 | 32.02 | 17.89 |
| **CONT** | $n$ = 6 | | $n$ = 32 | |
| T1 | 28.54 | 19.31 | 15.16 | 11.53 |
| T2 | 30.33 | 20.79 | 22.57 | 16.30 |
| T3 | 31.67 | 19.26 | 21.45 | 16.33 |

Notes: T1 = baseline, T2 = 1 month, T3 = 2 months, SD = standard deviation.

A separate 3 (INT/INTB/CONT) X 3 (youngest/middle/oldest) X 3 (baseline/1 month/2 months) repeated measures analysis of variance was conducted to examine differences in intervention effects based on age. Youngest/middle/oldest represented a breakdown of age into three groups, participants under 40 years of age ($\underline{n}$ = 38), those 41 – 54 years of age ($\underline{n}$ = 55), and those 55 years of age and over ($\underline{n}$ = 30). No significant interactions were detected ($\underline{p} > .025$). Significant main effects for age group, $F(2, 114) = 3.84$, $\underline{p} < .025$, $\eta^2 = .06$ and as expected, for time, $F(2,113) = 13.55$, $\underline{p} < .001$, $\eta^2 = .19$, were detected. Post hoc Tukey comparisons revealed the differences in age group were due to participants under 40 years of age reporting significantly greater levels of exercise behavior ($\underline{M}$ = 27.55, $\underline{SE}$ = 2.00) than participants 55 years of age and older ($\underline{M}$ = 18.83, $\underline{SE}$ = 2.43, $\underline{p} < .025$). Descriptive statistics for the three groups are shown in Table 4.

To further explore the data, particularly in light of the divergent pattern of exercise behavior change across gender that has been reported in the literature (USDHHS, 2000), change scores across time were compared for males and females separately. Change scores from baseline to 1 month, from 1 month to 2 months, and from baseline to 2 months were compared among the three groups using analysis of variance. Alpha was adjusted using the Bonferroni adjustment ($\alpha$ / 3) for tests of significance for the three ANOVAs. Thus, alpha was set to .02 for the analyses.

Table 4. Means and Standard Deviations for Exercise Behavior Over Time (Group - Age group)

| | Youngest | | Middle | | Oldest | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD |
| **INT** | n = 14 | | n = 13 | | n = 16 | |
| T1 | 18.07 | 7.80 | 19.85 | 10.20 | 14.06 | 10.64 |
| T2 | 32.43 | 16.80 | 31.23 | 11.80 | 23.50 | 16.91 |
| T3 | 29.64 | 18.21 | 33.00 | 15.30 | 22.50 | 13.80 |
| **INTB** | n = 13 | | n = 23 | | n = 8 | |
| T1 | 25.69 | 9.51 | 18.48 | 13.87 | 14.62 | 14.39 |
| T2 | 30.31 | 18.85 | 26.00 | 17.67 | 16.25 | 10.12 |
| T3 | 36.19 | 15.87 | 29.83 | 19.57 | 17.50 | 14.95 |
| **CONT** | n = 11 | | n = 19 | | n = 6 | |
| T1 | 16.73 | 12.05 | 16.26 | 13.42 | 22.54 | 19.66 |
| T2 | 29.41 | 17.58 | 22.74 | 17.20 | 20.33 | 17.72 |
| T3 | 29.45 | 20.39 | 22.40 | 16.43 | 18.17 | 11.32 |

Notes: T1 = baseline, T2 = 1 month, T3 = 2 months, SD = standard deviation.

While no significant group differences were revealed for either males or females, a close to significant group difference, $F(2, 90) = 3.73$, $p < .03$, was detected for females for exercise behavior reported from 1 month to 2 months. Post hoc Tukey comparisons revealed that this difference was due to a close to significant ($p = .03$) difference between the INT and INTB change scores. It would appear that for women, the booster postcard was somewhat effective in increasing exercise behavior from 1 month to 2 months, while the rate of exercise increase realized in the INT group from baseline to 1 month dropped off at 2 months. These findings were not surprising, as an examination of means and profile plots from the main analysis revealed that the greatest changes in exercise behavior occurred in

women in the INTB group. Additionally, the pattern of change exhibited by women reflected a trend in which exercise levels at 2 months increased from 1 month in the INTB group, while these levels remained relatively the same for the control group, and decreased slightly for the INT group (see Figure 3).

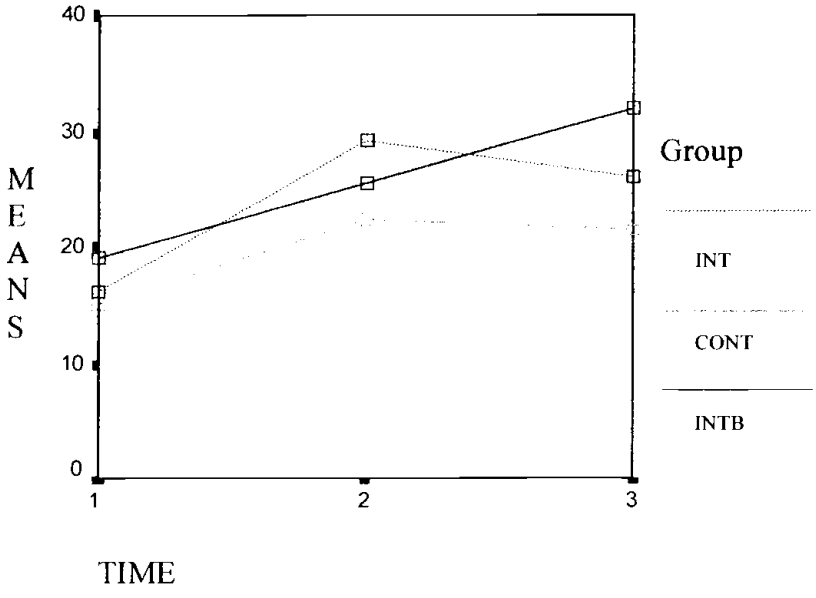


Figure 3. Exercise Behavior Across Time for Females

Hypothesis Three

It was hypothesized that those in the intervention groups would evidence significantly greater increases in the theoretically proposed mediating variables targeted by the intervention materials; perceptions of autonomy, perceptions of competence, and perceptions of relatedness, than those in the control group after 1

month. It was also hypothesized that adults in the INTB group would evidence significantly greater increases in these mediating variables after 2 months than adults in the INT and CONT groups.

Bivariate correlations among the perception of autonomy, perception of competence, and perception of relatedness variables were conducted at the three time periods to detect multicollinearity ($r \geq .70$). Correlations ranged from $\underline{r} = .08$ to $\underline{r} = .51$, suggesting multicollinearity was not an issue. Therefore, the three variables were analyzed using a multivariate approach. Alpha levels for tests of significance were adjusted using the Bonferroni adjustment ($\alpha / 2$) to account for the two repeated measures analyses that were conducted. Therefore, alpha was set to .03 for these analyses.

A 3 (INT/INTB/CONT) X 2 (male/female) X 3 (baseline/1 month/2 months) repeated measures multivariate analysis of variance was conducted to examine main and interaction effects for the dependent variables, perceptions of autonomy, competence, and relatedness. The Mauchly test of sphericity was significant for the perceptions of competence variable only, $\chi^2(2) = 6.40$, $\underline{p} < .05$, suggesting that the variances of the orthonormalized transformed dependent variables were not equal and/or that these variables were intercorrelated. Therefore the adjusted Huynh-Feldt values, in which the degrees of freedom are adjusted based on the extent of the sphericity assumption violation, were used in the within-subjects tests for perceptions of competence. No significant interactions were detected. A significant main effect for time was revealed, Wilks' $\lambda$ ($F(6, 115) =$

5.10) = .79, $p < .001$, $\eta^2 = .21$. Follow-up univariate analyses revealed this difference resulted from significant changes in perceptions of autonomy, $F(2, 240) = 6.53$, $p < .001$, $\eta^2 = .05$ and perceptions of relatedness, $F(2, 240)$, $p < .001$, $\eta^2 = .07$. Descriptive statistics for the three groups over time are shown in Table 5. Follow-up paired t-tests revealed that there were significant increases in perceptions of autonomy from baseline ($M = 3.03$, $SD = 1.10$) to 1 month ($M = 3.28$, $SD = 1.11$), $t(125) = 3.48$, $p < .01$ and from baseline to 2 months ($M = 3.28$, $SD = 1.07$), $t(125) = 3.48$, $p < .01$, but no significant differences from 1 month to 2 months ($p > .05$). Perceptions of relatedness increased significantly from baseline ($M = 2.21$, $SD = .66$) to 1 month ($M = 2.30$, $SD = .64$), $t(125) = 2.60$, $p < .05$ and decreased significantly from 1 month to 2 months ($M = 2.23$, $SD = .65$), $t(125) = 2.46$, $p < .05$. No significant differences in perceptions of relatedness were found between baseline and 2 months ($p > .05$).

A separate 3 (INT/INTB/CONT) X 3 (youngest/middle/oldest) X 3 (baseline/1 month/2 months) repeated measures multivariate analysis of variance was conducted to examine differences in intervention effects on the dependent variables of perceptions of autonomy, competence, and relatedness, based on age. Youngest/middle/oldest represented a breakdown of age into three groups, participants under 40 years of age ($n = 38$), those 41 – 44 years of age ($n = 55$), and those 55 years of age and over ($n = 30$). No significant interactions were detected ($p > .025$). As with the prior analysis, a significant main effect for time, Wilks' $\lambda$ (F

(6,109) = 4.95), = .79, $p < .001$, $\eta^2 = .21$, was detected. Descriptive statistics for the three groups over time are shown in Table 6.

Table 5. Means and Standard Deviations for Perceptions Over Time (Group - Gender)

| | Males | | Females | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| **INT** | n = 13 | | n = 30 | |
| Perceptions of Autonomy | | | | |
| T1 | 3.38 | 1.13 | 2.97 | 1.07 |
| T2 | 3.49 | .81 | 3.07 | 1.10 |
| T3 | 3.41 | .98 | 3.00 | 1.12 |
| Perceptions of Competence | | | | |
| T1 | 2.36 | .38 | 2.03 | .57 |
| T2 | 2.42 | .45 | 2.08 | .63 |
| T3 | 2.42 | .44 | 2.13 | .63 |
| Perceptions of Relatedness | | | | |
| T1 | 2.06 | .57 | 2.27 | .70 |
| T2 | 2.13 | .38 | 2.26 | .70 |
| T3 | 2.13 | .48 | 2.17 | .68 |
| **INTB** | n = 16 | | n = 29 | |
| Perceptions of Autonomy | | | | |
| T1 | 3.00 | 1.17 | 3.04 | 1.17 |
| T2 | 3.27 | .98 | 3.37 | 1.16 |
| T3 | 3.12 | 1.32 | 3.47 | 1.03 |
| Perceptions of Competence | | | | |
| T1 | 2.21 | .55 | 2.36 | .59 |
| T2 | 2.26 | .46 | 2.36 | .72 |
| T3 | 2.35 | .59 | 2.48 | .63 |
| Perceptions of Relatedness | | | | |
| T1 | 2.23 | .62 | 2.33 | .58 |
| T2 | 2.48 | .64 | 2.31 | .56 |
| T3 | 2.42 | .54 | 2.27 | .51 |
| **CONT** | n = 6 | | n = 32 | |
| Perceptions of Autonomy | | | | |
| T1 | 3.83 | 1.13 | 2.82 | 1.01 |
| T2 | 4.56 | 1.15 | 3.07 | 1.12 |
| T3 | 4.22 | .81 | 3.17 | .95 |

Table 5. (continued)

| | | | | |
|---|---|---|---|---|
| Perceptions of Competence | | | | |
| T1 | 2.69 | .59 | 2.13 | .65 |
| T2 | 2.61 | .57 | 2.19 | .62 |
| T3 | 2.75 | .60 | 2.25 | .64 |
| Perceptions of Relatedness | | | | |
| T1 | 1.83 | .74 | 2.18 | .74 |
| T2 | 2.35 | .77 | 2.32 | .74 |
| T3 | 1.94 | .83 | 2.25 | .81 |

Notes: T1 = baseline, T2 = 1 month, T3 = 2 months, SD = standard deviation

Table 6. Means and Standard Deviations for Perceptions Over Time (Group - Age group)

| | Youngest | | Middle | | Oldest | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD |
| **INT** | n = 14 | | n = 13 | | n = 16 | |
| Perceptions of Autonomy | | | | | | |
| T1 | 3.05 | 1.08 | 3.56 | 1.14 | 2.75 | .98 |
| T2 | 3.19 | 1.05 | 3.26 | 1.02 | 3.15 | 1.08 |
| T3 | 3.19 | .89 | 3.28 | 1.09 | 2.94 | 1.26 |
| Perceptions of Competence | | | | | | |
| T1 | 2.19 | .55 | 2.28 | .58 | 1.95 | .47 |
| T2 | 2.34 | .64 | 2.24 | .68 | 2.00 | .46 |
| T3 | 2.38 | .57 | 2.20 | .63 | 2.08 | .58 |
| Perceptions of Relatedness | | | | | | |
| T1 | 2.24 | .74 | 2.22 | .56 | 2.17 | .71 |
| T2 | 2.42 | .75 | 2.11 | .37 | 2.14 | .65 |
| T3 | 2.24 | .69 | 2.12 | .51 | 2.12 | .68 |
| **INTB** | n = 13 | | n = 23 | | n = 8 | |
| Perceptions of Autonomy | | | | | | |
| T1 | 3.31 | 1.05 | 3.00 | 1.20 | 2.29 | .49 |
| T2 | 3.77 | .83 | 3.19 | 1.18 | 2.75 | .61 |
| T3 | 3.69 | 1.00 | 3.25 | 1.16 | 2.92 | 1.22 |

Table 6. (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| Perceptions of Competence | | | | | | |
| T1 | 2.28 | .55 | 2.33 | .61 | 2.17 | .51 |
| T2 | 2.51 | .76 | 2.23 | .61 | 2.17 | .34 |
| T3 | 2.60 | .74 | 2.31 | .58 | 2.42 | .46 |
| Perceptions of Relatedness | | | | | | |
| T1 | 2.31 | .44 | 2.24 | .64 | 2.41 | .74 |
| T2 | 2.52 | .48 | 2.29 | .58 | 2.36 | .80 |
| T3 | 2.35 | .42 | 2.32 | .52 | 2.24 | .74 |
| **CONT** | n = 11 | | n = 19 | | n = 6 | |
| Perceptions of Autonomy | | | | | | |
| T1 | 3.12 | 1.09 | 2.84 | 1.24 | 2.89 | .50 |
| T2 | 3.30 | 1.07 | 3.23 | 1.32 | 3.22 | 1.29 |
| T3 | 3.52 | .62 | 3.19 | 1.24 | 3.22 | .81 |
| Perceptions of Competence | | | | | | |
| T1 | 2.35 | .70 | 2.26 | .75 | 1.94 | .27 |
| T2 | 2.39 | .63 | 2.30 | .70 | 1.97 | .37 |
| T3 | 2.67 | .65 | 2.29 | .67 | 2.03 | .39 |
| Perceptions of Relatedness | | | | | | |
| T1 | 2.39 | .66 | 2.10 | .84 | 1.88 | .57 |
| T2 | 2.46 | .49 | 2.35 | .89 | 2.19 | .52 |
| T3 | 2.27 | .65 | 2.24 | .92 | 2.15 | .85 |

Notes: T1 = baseline, T2 = 1 month, T3 = 2 months, SD = standard deviation

Hypothesis Four

A fourth goal of this study was to examine the pattern of relationships among the variables examined. It was hypothesized that a model in which perceptions of autonomy, competence, and relatedness influenced self-determined motivation, which then influenced exercise behavior would provide a better fit to the observed data than an alternative model in which perceptions of autonomy and

relatedness influenced self-determined motivation, which then influenced exercise behavior through perceptions of competence.

Structural equation modeling techniques using maximum likelihood estimation methods are relatively robust to violations of normality (Chou & Bentler, 1995). However, the presence of extreme outliers several standard deviations above the distribution mean and not close to any other observations may dramatically affect model fit indices and parameter estimates, and compromise model estimation, leading to improper solutions (West, Finch, & Curran, 1995). Excessive kurtosis values are particularly problematic (Bollen & Stine, 1993).

An examination of skewness and kurtosis values for all variables revealed a kurtosis value of 22.4 for the 7-day recall measure, one of the indicators of exercise behavior. A model-independent examination of measured variable plots revealed the presence of four extreme outliers (greater than 2 standard deviations above the next lowest observation in the distribution) on the 7-day recall of physical activity measure. These cases were removed from the analysis decreasing the measure's kurtosis value to 2.73. The structural equation modeling was thus conducted using 181 participants. Absolute skewness and kurtosis values for all variables ranged from .003 to1.66 and .043 to 2.73, respectively.

The proposed models were evaluated using multiple methods, including an examination of multiple fit indices, an assessment of parameter estimates, and consideration of the theoretical and practical implications of the model. This

strategy is generally advocated in the structural equation modeling literature (e.g., Hoyle & Panter, 1995).

Fit of the model was evaluated using several indices. While the $\chi^2$ test statistic provides an absolute index of fit, it is generally acknowledged that most models will not provide a perfect fit and as such, a test of the null hypothesis of perfect fit may be too restrictive (Arbuckle & Wothke, 1999). The relative chi-square, or chi-square divided by its degrees of freedom ($\chi^2$/df, Wheaton, Muthén, Alwin, & Summers, 1977), has been used to reduce the sensitivity of the chi-square statistic to sample size (Kline, 1998). Carmines and McIver (1981) suggest that a ratio of 3 or less to 1 is indicative of an acceptable fit.

The goodness of fit index (GFI), an additional absolute fit index, is analogous to the $R^2$ statistic and indicates the amount of variance in the observed data accounted for by the model (Hu & Bentler, 1995). A cutoff value of .90 is a general criterion for model acceptance. While some studies suggest the GFI may underestimate the population value in smaller sample sizes (e.g., $\underline{N}$ <250), Marsh, Balla, and McDonald (1988) found the GFI performed better than any other absolute fit index.

In addition to absolute indices of fit, incremental fit indices that compare the specified model to a more restricted baseline model also provide an evaluation of model fit. The comparative fit index (CFI), one of several incremental fit indices, performs with relative consistency in sample sizes under 250 (Hu & Bentler, 1995). CFI values over .95 indicate an adequate fit (Hu & Bentler, 1999).

Population discrepancy function measures also indicate model adequacy. These measures assess the discrepancy between the population covariance matrix and the covariance matrix of the specified model (Byrne, 2001). The root mean square error of approximation (RMSEA), a population discrepancy function that accounts for model complexity (Browne & Cudeck, 1993), was also used to assess model fit. RMSEA values of .05 or less indicate a close model fit, while values up to .08 indicate a reasonable model fit. Values greater than .10 reflect a poor fitting model (Brown & Cudeck, 1993).

Model acceptability was also evaluated with consideration of the parameter estimates, so as to yield meaningful interpretations of the model (MacCallum, 1995). Thus, in evaluating the quality of the hypothesized models, both the value of fit indexes and the strength of parameter estimates were assessed. Model assessment occurred in two steps, as described by Anderson and Gerbing (1988). A confirmatory factor analysis (CFA) measurement model was specified and evaluated in the first step with unanalyzed associations specified between all latent constructs. The structural models were then evaluated in the second step. In this way, the source of specification problems (i.e., measurement or structural model) might be more clearly evaluated than when using a one-step procedure (Kline, 1998).

Multiple indicators represented all latent constructs in the model. Perceptions of autonomy and perceptions of competence were indicated by the their respective measure items. Perceptions of relatedness were indicated by the friend

and family subscales of the social support measure due to the high number of items in the measure. Re-expression of items into parcels allows for more stable estimates in smaller sample sizes (West, Finch, & Curran, 1995). Exercise behavior was represented by the LTEQ and 7-day recall measure exercise index values. Self-determined motivation was represented by computing four separate indices based on the Exercise Motivation Scale (Li, 1999) items. Several studies support the validity and reliability of this procedure (Grolnick & Ryan, 1987; Guay & Vallerand, 1997; Vallerand & Bissonnette, 1992), which integrates the information from the different motivational subscales. The simplex pattern of relationships found in the exercise motivation scale further supports use of this index. Finally, this strategy reduces the high number of parameters and complexity of the model resulting from the high number of latent variables when each subscale is represented separately. In light of the sample size, this was deemed preferable.

Each index is derived by assigning a specific weight to each scale item based on its placement on the continuum of motivation. Thus intrinsic motivation, integrated regulation, and identified regulation items were weighted by +3, +2, and +1, respectively, where items for intrinsic motivation were weighted, combined and averaged (Guay & Vallerand, 1997). Introjected regulation, external regulation, and amotivation items were weighted by -1, -2, and -3, repectively, Each index was computed using the following formula [(3 X ((IM to learn + IM to accomplish + IM to sensate) / 3)) + (2 X Integrated Regulation) + (1 X Identified Regulation) + (-1 X Introjected Regulation) + (-2 X External Regulation) + (-3 X Amotivation)],

resulting in four indices based on four items per subscale. The fourth index did not include amotivation items as this subscale had only three items. Specification of the measurement model resulted in a good fitting model, $\chi^2(df = 109, N = 181) = 165.5$, $p < .001$, $\chi^2/df = 1.52$, CFI = .96, GFI = .90, RMSEA = .054. Parameter estimates were examined to assess the quality of the indicators in reflecting the latent constructs. All loadings of indicators on their respective latent constructs were significant. Standardized loadings were greater than .50 for all but one indicator, as shown in Table 7. The exercise index derived from the 7-day recall measure (eb2) had a moderate loading of .47 on exercise behavior. This indicator was retained, however, due to the significant and moderate ($r = .42$) correlation with the indicator of exercise behavior derived from the LTEQ measure (eb1), and the preferred use of multiple indicators of latent constructs (MacCallum, 1995). Standard errors associated with the indicators were generally low, and the variance explained in each indicator by its associated latent construct ranged from .22 to .86. Kline (1998) suggests that values around .30 indicate a moderate effect and those greater than .50 indicate a strong effect. While the variance explained in most latent constructs was generally moderate to strong, the variance explained in the 7-day recall measure (eb2) was low (.22) indicating the amount of error associated with this indicator was relatively high.

The model in which perceptions of autonomy, competence, and relatedness influenced self-determined motivation, which in turn influenced exercise behavior, was examined first. Examination of the fit indices suggested a good fit to the

sample data, $\chi^2(df = 112, N = 181) = 179.9$, $p < .001$, $\chi^2/df = 1.60$, CFI = .96, GFI = .90, RMSEA = .058. Parameter estimates indicating the relationships among the latent variables are shown in Figure 4. Solid lines indicate significant estimates ($p < .05$), while a dashed line indicates a non-significant estimate. As suggested by self-determination theory, perceptions of autonomy and perceptions of competence were positively related to self-determined motivation. Those individuals with

Table 7. Measurement Characteristics of Latent Constructs

| Construct | Indicator | Standardized loading | Standard error[a] | Variance explained |
|---|---|---|---|---|
| Perceptions of Autonomy | aut1 | .72 | | .51 |
| | aut2 | .81 | .09 | .66 |
| | aut3 | .74 | .09 | .55 |
| Perceptions of Competence | comp1 | .58 | | .34 |
| | comp2 | .72 | .10 | .52 |
| | comp3 | .73 | .10 | .54 |
| | comp4 | .80 | .10 | .64 |
| | comp5 | .78 | .10 | .61 |
| | comp6 | .71 | .09 | .50 |
| Perceptions of Relatedness | rel1 | .61 | | .38 |
| | rel2 | .74 | .28 | .55 |
| Self-determined Motivation | sdm1 | .83 | | .68 |
| | sdm2 | .93 | .06 | .86 |
| | sdm3 | .93 | .06 | .86 |
| | sdm4 | .86 | .06 | .74 |
| Exercise Behavior | eb1 | .90 | | .81 |
| | eb2 | .47 | .18 | .22 |

Note: [a] not shown for scaled indicators.

higher perceptions of autonomy and competence in exercise behavior reported greater levels of self-determined motivation. The path from perceptions of relatedness to self-determined motivation was not significant. Together, perceptions of autonomy, competence, and relatedness explained 41% of the variance in self-determined motivation. As predicted by self-determination theory, self-determined motivation had a significant positive influence on exercise behavior. Individuals who were more self-determined in their motivation to exercise exhibited higher levels of exercise behavior. The model explained 8% of the variance in exercise behavior.

An examination of indirect effects was of interest, as the proposed model was mediational in nature. Indirect effects were calculated by computing the product of direct path loadings on latent variables in the mediation pathway. The indirect effects of perceptions of autonomy (.13) and perceptions of competence (.08) on exercise behavior were both significant ($p < .05$), while the indirect effects of perceptions of relatedness on (-.01) exercise behavior were not significant.

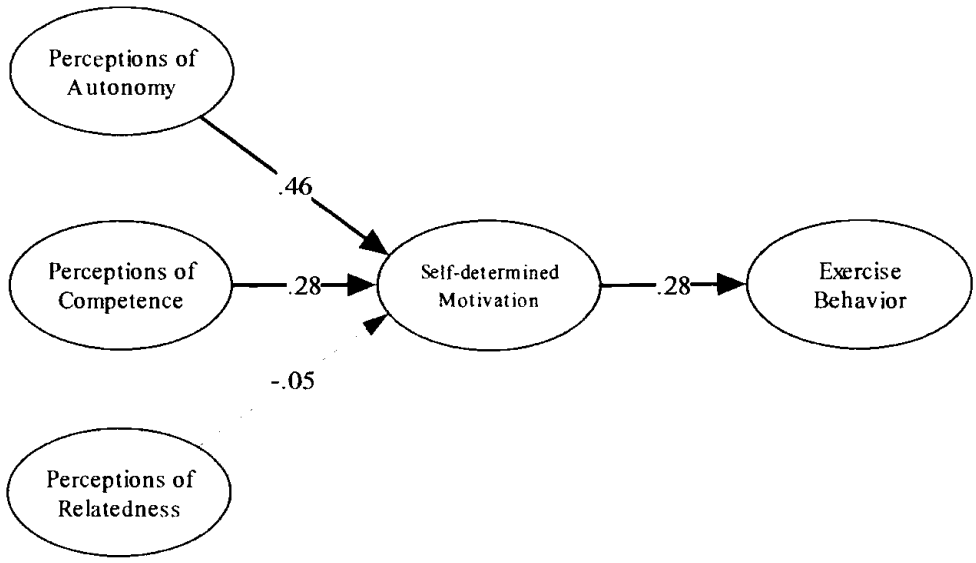


Figure 4. Model A Path Loadings. Note: Standardized coefficients are shown.

An alternative model in which perceptions of autonomy and relatedness influenced self-determined motivation, which then influenced exercise behavior through perceptions of competence, was also examined. Initial model estimation resulted in a negative error variance for the friend relatedness indicator. Therefore, as recommended by Kline (1998), error variance was fixed to a value representing the amount of measurement error associated with that indicator. This value, .11, was based on the friend subscale reliability coefficient of .89, such that $1 - \alpha = .11$.

As with Model A, the fit indices suggested a good model fit to the observed data, $\chi^2(df = 115, \underline{N} = 181) = 185.7$, $p < .001$, $\chi^2/df = 1.62$, CFI = .95, GFI = .89, RMSEA = .058. Parameter estimates indicating latent variable relationships are

shown in Figure 5. Here again, a solid line indicates significant loadings, while a dashed line represents non-significant loadings. As indicated in Figure 5, perceptions of autonomy had a significant positive influence on self-determined motivation, while, as in Model A, the relationship of perceptions of relatedness to self-determined motivation was not significant. Self-determined motivation had a significant positive influence on perceptions of competence, which had a significant positive influence on exercise behavior. Individuals who reported higher perceptions of autonomy had more self-determined motivation for exercise, greater perceptions of competence, and reported higher levels of exercise behavior. The model explained 35% of the variance in self-determined motivation, 25% of the variance in perceived competence, and accounted for 13% of the variance in exercise behavior.

An examination of indirect effects revealed that perceptions of autonomy had a significant indirect effect on perceived competence (.30, $p < .01$) and exercise behavior (.11, $p < .05$). As expected, perceptions of relatedness did not have a significant indirect effect on either perceived competence ($p > .05$) or exercise behavior ($p > .05$). Self-determined motivation had a significant indirect effect on exercise behavior (.18, $p < .05$).

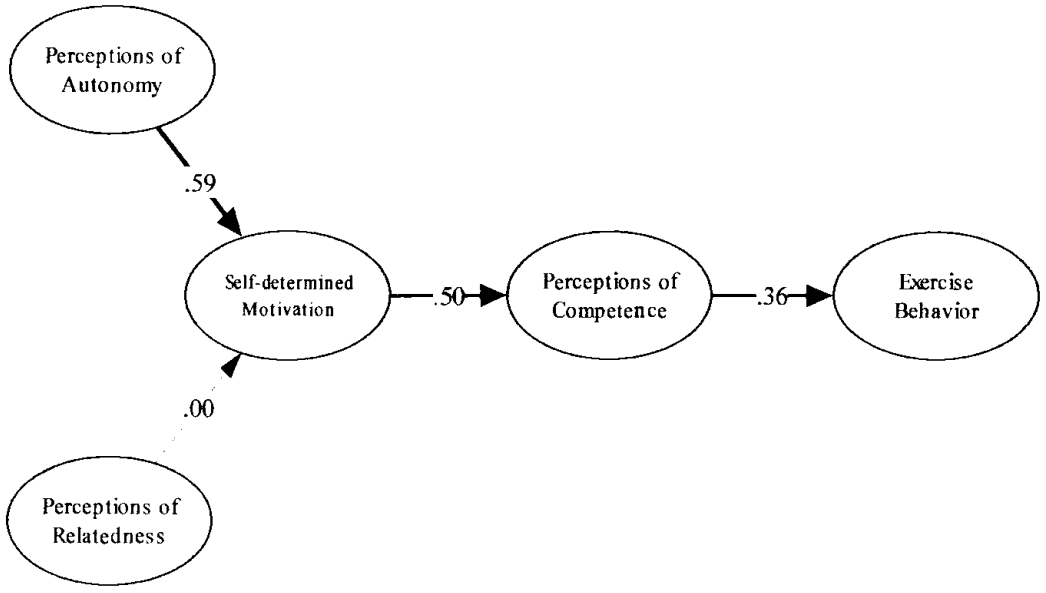


Figure 5. Model B Path Loadings. Note: Standardized coefficients are shown.

As both models were mediational in nature, and provided a good fit to the observed data, a further exploration of the proposed mediated relationships was deemed warranted. Specifically, it was of interest whether self-determined motivation mediated the relationship between perceptions of competence and exercise behavior, as suggested by Model A, or if perceptions of competence mediated the relationship between self-determined motivation and exercise behavior, as suggested by Model B. Baron and Kenny (1986) provide a test of mediation that they suggest may be well suited to structural equation models.

The test takes place in three steps and involved the addition of direct paths in both models. First paths from the independent variable(s) to the proposed

mediating variables were examined. Next, direct paths from the independent variable to the dependent variable were specified and examined. Finally, direct paths from the independent and mediator variables to the dependent variable were specified and examined. According to Baron and Kenny, relationships in Steps One and Two should be significant. At Step Three the relationship between the mediating variable and dependent variable should be significant, and mediation holds if the effect of the independent variable on the dependent variable is less, or in the case of perfect mediation disappears, during Step Three. As perceptions of relatedness were not significantly related to other variables in both Models A and B, it was expected that this variable would make no significant contribution to the mediational test. The variable was retained in the models during the test to preserve the integrity of the original models tested however, excluded from examination.

In Model A, Step One involved an examination of the path from perceptions of autonomy and perceptions competence to self-determined motivation. Both paths (.46 and .28, respectively) were significant ($p < .05$). Next, direct paths from perceptions of autonomy and perceptions of competence to exercise behavior were specified and examined. During this step the path from self-determined motivation to exercise behavior was removed. Here, only the path from perceptions of autonomy to exercise behavior (.21) was significant ($p < .05$). Finally, at Step Three, a direct path from self-determined motivation to exercise behavior was added. All paths in the model became non-significant. While the path from perceptions of autonomy to exercise behavior (.19) was not as strong as in Step

Two, non-significant paths in Step Two and again in Step Three indicate that Model A did not pass this test of mediatonal effects.

In Model B, Step One involved an examination of the path from self-determined motivation to perceptions of competence. This path (.36) was significant ($p < .05$). A direct path from self-determined motivation to exercise behavior, excluding perceptions of competence was specified in Step Two. The path (.27) was significant ($p < .05$). Step Three involved the addition of a direct path from perceptions of competence to exercise behavior. The path from perceptions of competence to exercise behavior (.30) was significant ($p < .05$), and the path from self-determined motivation had become non-significant (.12). Thus, perceptions of competence appeared to mediate the relationship between self-determined motivation and exercise behavior.

## Process Evaluation

Of the 30 females in the INT group, 22 (73%) completed a process evaluation questionnaire. Twenty-two women (100%) reported receiving the intervention packet, 19 (86%) reported reading the packet, and 8 (36%) reported completing the worksheets contained in the packet. Twelve (77%) of the 13 men in the INT group completed the process evaluation questionnaire. Eleven men (85%) reported receiving the intervention packet. Of those, 9 (82%) reported reading the packet, and 4 (36%) reported completing the worksheets.

In the INTB group, 24 (83%) of the 29 females in the group completed the process evaluation questionnaire. Of those 24 (100%) reported receiving the initial intervention packet, 22 (76%) reported reading the initial intervention packet, and 16 (67%) reported completing the worksheets contained in the packet. Twenty-three women (96%) reported receiving the booster postcard and 22 (96%) reported reading the postcard. For men in the INTB group, 14 (88%) of 16 completed the process evaluation questionnaire. Of those, 11 (79%) reported receiving the initial intervention packet. Of those who reported receiving the packet, 10 (91%) reported reading the packet, and 6 (55%) reported completing the worksheets. Ten men (71%) reported receiving the booster postcard and nine (90%) reported reading the postcard.

In the CONT group, 27 (84%) of the 32 women in the group completed the process evaluation questionnaire. Of those, 27 (100%) reported receiving the control packet, and 25 (93%) reported reading the packet. For the six men in the CONT group, five (83%) completed the process evaluation questionnaire. Of those, five (100%) reported receiving the packet and two (40%) reported reading the packet.

# DISCUSSION

The first goal of this study was to examine the effect of a mail-mediated intervention on exercise behavior in adults. Results did not support the hypothesis that those in the intervention groups would evidence significantly greater exercise behavior at 1 month than those in the control group. Support was also not found for the second hypothesis that those in the intervention-plus-booster group would exhibit greater levels of exercise behavior after 2 months than those in the intervention-only and control groups. While significant increases in exercise behavior were reported in all three groups after 2 months, no significant differences were found between the intervention and control groups in exercise behavior change. For females, however, a pattern of increased exercise behavior emerged in the intervention plus booster group from 1 month to 2 months that was not found in the intervention only and control groups. Exercise behavior levels of those in the intervention only and control groups declined from 1 month to 2 months. This pattern suggests that the booster postcard was somewhat effective for females in this sample. This effect might also be explained by the fact that females in the intervention-plus-booster group appeared to be more compliant with regard to use of the initial implementation materials than females in the intervention-only group. As this effect was only a trend however, caution is given in any conclusions made from this finding. Future studies may be well advised to further investigate this effect.

The majority of interventions using some type of booster to an initial program have used telephone contact. A combination of mailed newsletters and follow-up phone calls were used for 18 months following an initial face-to-face physical activity intervention in college students (Calfas et al., 2000). No significant differences in physical activity were found however, between the extended intervention group and a control group. In interventions using follow-up telephone contacts, the contacts have been of varying length, frequency, and structure. Telephone contacts that were used to follow-up initial face-to-face instruction on exercise and use of activity logs increased fitness measures after 6 months when compared to instruction with no telephone contact in a home-based exercise program for middle-aged males and females. The telephone contacts were used to provide feedback and support to participants (King, Taylor, Haskell, & DeBusk, 1988). Telephone contacts were also used in combination with mail-mediated printed materials as part of a behavioral intervention to increase walking behavior in ethnic minority women. This combined behavioral intervention was no more effective than mail-mediated educational materials in increasing walking behavior in the women (Chen et al., 1998). In fact, dropout rates were higher in the behavioral intervention group than the educational group. The authors suggest that the long length of the calls (average over 20 min) may have been detrimental. Shorter duration telephone contacts (King et al., 1988) and more frequent telephone contacts (Lombard, Lombard, & Winett, 1995) have been more effective in increasing exercise behaviors. The findings of the current study suggest that for

women, a combination of a booster that is both theoretically-based and of minimal contact, such as a postcard, has the potential to be an effective catalyst for increasing exercise behavior.

All three groups reported increases in the proposed mediators of change: perceptions of autonomy, perceptions of competence, and perceptions of relatedness over time however, no significant differences were found among the groups. Few studies have examined changes in self-determination mediating variables post-intervention, so it is difficult to make direct comparisons to the existing self-determination literature. Within the framework of the transtheoretical model, Marcus, Emmons, et al. (1998) found that compared to a control group, significantly greater increases in exercise stage of change in a group receiving individually-tailored, motivationally-matched mail-mediated printed materials were not accompanied by significantly greater increases in the proposed mediators of change at 3 months. The importance of examining the role of mediating variables in intervention research has been repeatedly advocated (e.g., Baranowski et al., 1998, Sallis, 2001), and the findings of the current study support this contention.

One possible explanation of the failure of the intervention to produce significantly greater increases in exercise behavior than the control materials is the failure of the intervention materials to effectively manipulate the proposed mediators of change. To the investigator's knowledge, this was the first study to report the effect of mail-mediated printed materials on these particular perceptions. Perhaps, more direct manipulations, such as those used in the laboratory (Deci et

al., 1994) or in the classroom (Boggiano et al., 1993) are needed. It is possible that perceptions of autonomy, competence, and relatedness are better influenced through face-to-face intervention programs than through mediated efforts. Findings in the academic and health care domains attest to the viability of such approaches, and interventions in the physical domain suggest that at least one of the mediators, perceptions of competence, can be increased thusly (e.g., Theeboom, De Knop, & Weiss, 1995).

It is also possible that a longer period of time is needed in order for these variables to be influenced by print media in the physical domain. While printed media physical activity interventions seem to be more effective in the short-term (Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998), some support exists for the contention that the effect on mediating variables takes place over a longer period of time. Six-months post-intervention, participants in both an individually-tailored, motivationally-match intervention group and a control group who had reached CDC/ACSM minimum recommended physical activity criteria, reported significantly greater levels of self-efficacy, and endorsement of more behavioral processes of change than study participants not reaching these criteria (e.g., Bock et al, 2001). While not providing evidence of the effectiveness of the intervention in increasing proposed mediators in this study, these data do suggest that change of mediating variables may be a long-term process. It also possible that participation in exercise itself leads to increases the proposed mediating variables.

The increases in exercise behavior experienced in all groups are possibly explained by the baseline exercise behavior characteristics of the sample. By definition, those in the preparation stage of exercise are ready to become regular exercisers. Thus, it may be that only minimal stimulation, provided by the receipt of either the informational control packet or the intervention materials, was necessary to effectuate exercise behavior change, or that due to their state of readiness to change, activity increases would have occurred over this time period without any stimulation. It is also possible that differences in stage movement may have occurred that were not matched by changes in exercise behavior as measured by the LTEQ exercise index score. Marcus, Emmons, et al. (1998) reported significant differences in stage movement in participants receiving a stage-matched mail-mediated intervention when compared to a mail-mediated control group however, no significant differences were found in exercise behavior as measured by self-reported minutes spent in exercise after 3 months. While the correlation between stage of exercise behavior and other self-report measures of exercise behavior has consistently been supported in the literature (e.g., Cardinal & Sachs, 1996; Marcus & Simkin, 1993), it is possible that the sensitivity of the two measures to changes in physical activity levels differs.

Another possible explanation of the failure to find significant differences between the intervention and control groups is the implementation of the intervention. Several successful mail-mediated interventions have been part of larger health behavior projects (e.g., Marcus et al., 1992; Marcus, Emmons, et al.,

1998) and/or have included feedback of participants' current fitness or exercise behavioral status (e.g., Cardinal & Sachs, 1996; Marcus, Bock, et al., 1998). While significant increases in exercise behavior over time were evidenced in the intervention groups in the current study, perhaps the intervention would have been more effective if used in conjunction with feedback, prompting from a physician, or as part of a larger program. The results of the process evaluation seem to indicate that the majority of participants both received and read the intervention packets and postcards. Completion of worksheets contained in the intervention packet was more varied between the two intervention groups. About half of those in the intervention plus booster group reported completing the worksheets, while less than half reported completing the worksheets in the intervention only group. In general, compliance with regard to the reported completion of worksheets was low in both intervention groups. As these worksheets incorporated self-determination behavioral strategies, lack of compliance may have led to the lack of significant intervention–control group differences. Perhaps these compliance rates would be higher had the intervention been implemented differently. Additionally, results of the process evaluation must be viewed with caution, as the evaluations were self-report and participants may have been reluctant to report not reading or using intervention materials.

Finally, the failure to find significant effects of the intervention may have been due to a lack of power. While the initial sample size was sufficient to detect a small effect size and the gender breakdown across groups was relatively equal,

dropout from the study resulted in unequal gender distribution across groups, particularly in the control group. While every effort was made to retain participants throughout the study, dropout resulted in diminished power to detect small effects.

The pattern of exercise behavior change noted in females was not exhibited in males. While only a trend, and therefore viewed with caution, this finding does suggest that intervention response differences between men and women may warrant further investigation. The differential gender effect of mail-mediated interventions has received minimal attention in the literature; however, support for the efficacy of mail-mediated interventions with females has been supported. Cardinal and Sachs (1996) found that a theoretically based mail-mediated intervention packet produced significantly greater increases in exercise behavior than a control mail-mediated packet in a female-only sample, after 1 month. A pre-experimental trial using mail-mediated stage of exercise tailored printed materials increased stage of exercise behavior after six weeks in a sample of worksite employees that was 80% female (Marcus et al., 1992). A second worksite study reporting significant increases in stage of exercise behavior as a result of stage-matched mail-mediated printed materials was conducted in a sample of more equal gender distribution (53.9% male, 46.1% female) however, gender differences were not examined (Marcus, Emmons, et al., 1998).

No evidence was found for the effect of age on intervention effects. While significant differences were found in exercise behavior between the oldest and youngest age groups, with the youngest group reporting significantly greater

exercise levels than the oldest group, no interactions with group membership were noted. Decreases in exercise behavior with increasing age have been well documented (USDHHS, 2000), and this finding was not surprising. The failure to detect any interaction with group membership may have been due to sample size and age group distribution across the groups, and issues associated with the intervention itself, and noted above. Future studies may wish to further explore age group differences in response to interventions with larger samples with a broader distribution of age groups across intervention and control groups.

Although no significant differences were found in the proposed mediators of change some support for the theoretical relationships among variables was found. As suggested by self-determination theory, a simplex-like pattern of intercorrelations among the various forms of motivation supported the existence of a continuum of motivation ranging from amotivation to intrinsic motivation. Similar support for this pattern of relationships has been reported elsewhere in the exercise domain (Li, 1999).

A surprising finding was the lack of support for the sequencing of relationships suggested by self-determination theory and the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997; Vallerand & Losier, 1999). Two tests of mediation provided only partial support for a model in which the influence of perceptions reflecting psychological needs on exercise behavior were mediated by self-determined motivation, as theoretically proposed. Greater support was found for a model in which perceptions of competence mediated the

relationship between self-determined motivation and exercise behavior, reflecting a sequence suggested by Boggiano's (1998) diathesis-stress model. Boggiano has used the model to explore achievement patterns in school children. Over a 2-year period, she found that self-determined motivation at Year One predicted perceptions of competence at Year Two, while perceptions of competence at Year One did not predict self-determined motivation at Year Two. Recently, Guay, Boggiano, and Vallerand (2001) found support for this pattern of relationships in elementary school students. They found greater support for a model in which intrinsic motivation mediated the relationship between teachers' provision of autonomy support and perceived competence than one in which perceived competence mediated the relationship between teachers' provision of autonomy support and intrinsic motivation.

Research examining the role of autonomy supportive environments in health care contexts has also provided some support for the pattern of relationships found in the current study. Motivational orientations of 2nd year medical students predicted perceptions of competence, and over time, increases in perceptions of competence, as a function of autonomy support provided by physician instructors, were mediated by changes in autonomous motivation (Williams & Deci, 1996). Similarly, Williams, Freedman, and Deci (1998) found patients' with diabetes perceptions of autonomy support from caregivers related to increases in autonomous motivation, which led to increases in perceptions of competence which led to improved glucose control over a 12-month period. There is also some

support for a similar pattern of relationships in the physical domain. Goudas, Biddle, and Fox (1994) found that perceptions of competence mediated the effect of a relative autonomy index score on intention to return to football and netball play in adolescent physical education students.

The findings of the current study, in conjunction with prior research in this area, illuminate the need for greater clarification regarding the pattern of relationships among self-determination variables, particularly between self-determined motivation and perceptions of competence. This is evident in the divergent findings of studies investigating these relationships. Boggiano (1998) addresses the confusion of discrepant findings regarding the sequencing of relationships among perceptions of competence, motivation and behavior in her discussion of the diathesis-stress model. As other authors have suggested (e.g., Boggiano, 1998; Guay et al., 2001), it is likely that the relationship between perceptions of competence and self-determined motivation is cyclical. Other patterns of relationships between these variables should also be investigated, as some support has been found for models in which self-determined motivation has a moderating influence on perceptions of competence (Guay et al., 2001, Markland, 1999).

A related issue brought to light in this study is the need for more consistent use of measures and definitions of self-determined motivation and perceptions of autonomy. It is difficult to clarify the pattern of relationships among psychological needs, self-determined motivation, and behavior, without consistency. While the

measures used in self-determination research have, in general been reliable and valid, a more precise definition of variables will elucidate their respective influence on exercise behavior. For example, self-determined motivation has been represented by measures of locus of causality (e.g., Markland, 1999), self-determined motivation continuum scales (e.g., Mullan & Markland, 1997), and study-specific adapted and developed scales (e.g., Ferrar-Cajas & Weiss, 2000). The use of valid and reliable measures for each of these constructs would benefit future researchers and redress a shortcoming in self-determination and exercise behavior research.

Measurement issues also provide a possible explanation for the failure of perceptions of relatedness to significantly influence self-determined motivation in either model. The current study used a previously validated and reliable exercise-specific measure of social support and that was deemed preferable to more general measures of social support used in prior self-determination studies (e.g., Li, 1999). However, it is possible the measure failed to accurately capture the nature of relatedness as proposed by self-determination theory. Ryan and Solky (1996) suggest that in order for social supports to be facilitative, they must be characterized by support of an individual's sense of autonomy. Perhaps, a better measure of the relatedness construct in the exercise domain would clarify the role of relatedness in the self-determination-exercise behavior relationship.

A strength of the current study was that is was the first to attempt to manipulate those environmental supports proposed by self-determination theory to

influence self-determined motivation, and subsequently behavior in the exercise domain. This study also addressed a shortcoming in the current exercise behavior research by examining the impact of the intervention on proposed mediators of change, as advocated in the physical activity behavioral research (e.g., Sallis, 2001). Furthermore, the current study is one of the few to document the entire set of links among psychological needs, self-determined motivation, and exercise behavior. Structural equation modeling proved to be a useful tool for exploring the pattern of theoretical relationships, and combined with additional empirical tests of mediation (i.e., Baron & Kenny, 1986) provided support for a model that better explained exercise behavior.

Prior self-determination research in the physical domain has typically examined exercise behavior in more structured contexts, such as exercise classes (Li, 1999; Markland, 1999) or physical education classes (Goudas et al., 1994). In light of interventions suggesting that lifestyle, unstructured, or home-based exercise programs may be more effective in helping individuals to adopt and maintain exercise behaviors (e.g., Cardinal & Sachs, 1996, King et al., 1991), the current study focused on encouraging both unstructured and structured activity. Finally, an additional strength of this study was the inclusion of a mechanism for process evaluation. Particularly with mediated interventions it is important to understand if and how intervention materials are being implemented.

Several limitations of the current study must also be acknowledged. First, while suggesting that the use of the intervention booster was beneficial to females,

the relatively small number of males in the sample did not allow a full comparison of effects. Similarly, the current study was unable to address gender invariance in the theoretical pattern of relationships, due to sample size. Second, any generalizations beyond this sample should only be made with caution. While an attempt was made to sample a diverse population, and specific strategies, such as recruitment through churches as recommended by the Centers for Disease Control, were employed, the majority of the sample was Caucasian and upper middle-class. One of the great benefits of mail-mediated interventions is their ability to be widely distributed with relative ease and low-cost, thus making them a viable intervention delivery mechanism to disadvantaged groups. However, due to demographic makeup, this issue could not be properly addressed in the present investigation. Additionally, all measures used in the current study were self-report including those used for exercise behavior. While other researchers have attested to the validity and reliability of these measures (e.g., Cardinal & Sachs, 1995; Jacobs et al., 1993), and correlations with objective measures of physical activity have been reported (Leenders, Sherman, & Nagaraja, 2000) the use of self-report measures might benefit from the use of additional objective measures.

Future researchers should continue to seek clarification of the pattern of relationships among self-determination variables. Structural equation modeling techniques that include an instrumental variable could easily examine a potential reciprocal relationship between perceived competence and self-determined motivation. Moreover, combined with a longitudinal design, the cyclical pattern of

relationships between these two variables could be explored. It is also possible that alternative models not examined in the current study do as good a job of explaining exercise behavior. Equivalent models that provide as good a fit to the sample data were not generated (see MacCallum, Wegner, Uchino, and Fabrigar, 1993, for a discussion of equivalent models). If such models are substantively and theoretically meaningful, they warrant future investigation.

It appears that a mail-mediated intervention may be a viable means of increasing exercise behavior, and that, particularly for women, minimal contact, theoretically-based boosters may lead to further increases and maintenance of exercise behavior. Health practitioners, health clubs, schools, and community organizations might well consider the use of such interventions, particularly in combination with other programs to increase adoption and maintenance of exercise behaviors. While the relationships among variables warrant clarification, self-determination theory may provide a viable framework within which to continue to develop interventions to help increase the number of individuals participating in regular exercise behavior.

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# APPENDICES

# Appendix A

Intervention

# ON THE MOVE

**Congratulations** on deciding to become more physically active! Whether you've decided to include structured exercise in your life, or to increase your levels of daily lifestyle physical activity, you have taken a step towards increased health and vitality!

Try to remember **your** reasons for deciding to start exercising or being physically active on a regular basis. Maybe you had one main reason or maybe you had many - there certainly are lots of them! Remembering and writing those reasons down can help motivate you at times when getting started seems especially tough. Here's a list of some of the reasons why people choose to be more physically active. You could put a check next to reasons that apply to you, and write down your own reasons if they're not on the list!

Helps relieve stress ___
Gives you energy ___
Makes you feel good ___
Get to be with friends ___
Helps you lose weight ___
Helps maintain weight loss ___
Tones your muscles ___
Reduces risk of heart disease ___
Meet new people ___
Helps manage blood pressure ___
Helps you feel more confident ___
Makes you feel strong ___
Makes you feel like a good role model ___
Do your work without feeling tired ___

My Other Reasons

_____
_____
_____
_____
_____
_____

## Every little bit counts!

Often each day can present the opportunity for you to ***take charge*** and add physical activity to your usual routine. Try to pick something that will be **fun** for you! You might also **ask a friend** to join you! You may choose to start with these types of physical activities and then work your way up to higher intensity activities.

Here are just a few ways to increase the physical activity you get on a daily basis. Can you think of some other ways to make your day more active? There's space for you to add those in, below.

Bicycling or walking to the store
Parking your car far away from your destination
Taking the stairs instead of the elevator
Bicycling or walking to work
Taking a walk during your lunch break

_____
_____
_____
_____
_____
_____

**Choose your exercise**

There are lots of ways for you to be more physically active. You can **choose** what works best for you and will be **fun** too. Listed below are some of the things you can do to increase the duration and intensity of your physical activity levels. Gradually, you can increase the times and intensity levels at which you do these activities.

Walking
Fast dancing
Raking leaves
Digging in the garden
Hiking
Bicycling
Doing aerobics (e.g., step, kick-boxing, jazzercize)
Doing aerobics to a workout video at home
Doing water aerobics
Swimming laps
Playing basketball
Jumping rope
Running
Stair climbing
Playing touch football
Playing volleyball

Did some of the activities appeal to you? Maybe you have some others you'd like to try. Take a moment to decide what activities you enjoy and are willing to try. Perhaps these choices come from the list above. Maybe they're activities you've done before, or activities you've always wanted to try.

Activity # 1 _____

Activity # 2 _____

Activity # 3 _____

Activity # 4 _____

Activity # 5 _____

Activity # 6 _____

Activity # 7 _____

## Initiate, then participate

Now that you've made some decisions about what kind(s) of activities you'd like to do, let's see how you might fit them into your schedule. Setting goals each week can help you fit exercise into your schedule. Goals usually work best when they are specific, measurable, realistic, and time-bound. For example, writing a goal ...
"to walk briskly (*specific*) for 30 (*measurable*) minutes (if that is *realistic* for you) this morning (*time-bound*),"
... meets all the criteria.

You can try writing a goal for yourself here:

_____

_____

Is there someone you can rely on to support your new exercise habit, someone who might give you some encouragement when you need it? Do you have an "exercise buddy" who might be interested in the same thing, or a family member who might provide encouragement? Maybe you can convince one of your exercise "supporters" to join you, or lend a supportive ear!

Here's a Calendar to help you fit your chosen activities into your schedule. *Remember*, rest days are OK too! You can simply write down what you plan to do. Here's an example of how you might use the calendar.

*Example:*

Monday AM *Walk briskly in neighborhood, 20 minutes.* PM_____

Wednesday AM_____ PM *Rake leaves, 35 minutes*

Week 1:

Monday AM_____ PM_____

Tuesday AM_____ PM_____

Wednesday AM_____ PM_____

Thursday AM_____ PM_____

Friday AM_____ PM_____

Saturday AM_____ PM_____

Sunday AM_____ PM_____

Week 2:

Monday AM_____ PM_____

Tuesday AM_____ PM_____

Wednesday AM_____ PM_____

Thursday AM_____ PM_____

Friday AM_____ PM_____

Saturday AM_____ PM_____

Sunday AM_____ PM_____

Week 3:

Monday AM_____ PM_____

Tuesday AM_____ PM_____

Wednesday AM_____ PM_____

Thursday AM_____ PM_____

Friday AM_____ PM_____

Saturday AM_____ PM_____

Sunday AM_____ PM_____

Week 4:

Monday AM_____ PM_____

Tuesday AM_____ PM_____

Wednesday AM_____ PM_____

Thursday AM_____ PM_____

Friday AM_____ PM_____

Saturday AM_____ PM_____

Sunday AM_____ PM_____

## *Hey, sometimes I just don't feel like it!*

You're right. Adding physical activity or exercise to your routine is sometimes hard work! You've taken a big step, and sometimes it means having to change your schedule or normal routine. You may feel like there are other things that you could be doing with that time and you may experience conflicted feelings. This is understandable.

Thinking about the reasons you started exercising can be helpful in resolving these feelings. You may wish to think about how exercise fits in with your other life values and goals too!

Congratulations on deciding to stick with it!

**Remember to give yourself a pat on the back when you've accomplished a goal!** You've taken a big step to becoming a regular exerciser! You can be proud of the improvements you make as you move closer to your long-term goals!

One reward might be the **internal satisfaction** you feel, and increased strength, endurance, and vitality. Other rewards can be anything that you like, such as a relaxation break during the day, or taking yourself out to a movie.

Things that are rewarding to me

_____

_____

_____

_____

## Whoops, I slipped back!

Sometimes, we all will have slip-ups and return to old sedentary habits. That's OK, you can get "back in the saddle" again! You may wish to think of how you will cope with slip-ups and plan ahead.
For example:

- If you usually walk during lunch hour and one day it is raining too hard to go outside, you might substitute another activity, such as climbing stairs, walking briskly inside, or increasing your activity the next day.

- Perhaps you've scheduled a walk one day, and just don't feel like it. You might encourage a friend to join you, or perhaps remind yourself of why you do the activity in the first place, and how you'll feel afterwards.

You can think of situations that will make it hard for you to exercise. What strategies might you use to overcome those situations?
Potential Situation

_____

Strategies I can use

_____

_____

_____

# Appendix B

**Booster Postcard**

Hello Study Participant!

Just a note to let you know we're thinking about you!

- Remember that every little bit of physical activity counts - each day you can take charge and choose how to add physical activity to your usual routine
- Try to remember your reasons for starting to exercise or becoming more physically active
- Slip-ups are OK. Adding physical activity is sometimes hard work!
- Give yourself a pat on the back when you've accomplished a goal!
- You might seek out exercise buddies for support

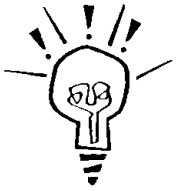
# Appendix C

American Heart Association Control Packet

# PHYSICAL ACTIVITY & HEALTH

Cardiovascular disease (CVD) is the No. 1 killer in America. About 960,000 Americans died of CVD in 1995, so CVD accounted for about 41.5 percent of all deaths. Lack of physical activity is now clearly shown to be a risk factor for heart disease.

- Scientists have not found a direct link between regular exercise and stroke. But they do know that exercise reduces the risk of other health problems, such as heart disease, which can contribute to stroke. By helping to prevent heart attack, exercise may reduce the risk of some kinds of embolic stroke.
- Estimates are that up to 250,000 deaths per year in the United States. — about 12 percent of total deaths — are due to a lack of regular physical activity.
- The relative risk of coronary heart disease associated with physical inactivity ranges from 1.5 to 2.4, an increase in risk comparable with that observed for high cholesterol, high blood pressure and cigarette smoking.
- Less active, less fit persons have a 30-50 percent greater risk of developing high blood pressure.
- Participation in regular physical activity gradually increased during the 1960s, 70s and early '80s but seems to have leveled off in recent years.
- Surveys show that 24 percent of Americans age 18 or older are not active at all. 54 percent of adults get some exercise, but they don't do it regularly or intensely enough to protect their hearts. Only 22 percent of American adults get enough leisure time exercise to achieve cardiovascular fitness.



- People with lower incomes and less than a 12th grade education are more likely to be sedentary.
- Of people age 55 and older, 38 percent report essentially sedentary lifestyles.
- The National Children and Youth Fitness Study, completed in 1987, found that at least half of youth don't engage in physical activity that promotes long-term health, that less than 36 percent of elementary and secondary schools offer daily PE classes and that mast classes were unlikely to faster lifelong physical activity.

- The 1991-92 Behavioral Risk Factor Surveillance Study data show the following have a sedentary lifestyle:
  - ✓ Among whites, 56.2 percent men and 56.4 percent women
  - ✓ Among blacks, 62.8 percent men and 67.7 percent women
  - ✓ Among Hispanics, 61.5 percent men and 61.9 percent women
  - ✓ Among Asian/Pacific Islanders, 56.6 percent men and 64.7 percent women
  - ✓ Among American Indian/Alaskan Natives, 50.8 percent men and 64.1 percent women
- Even low-to-moderate intensity activities, when done for as little as 30 minutes a day, can bring benefits. These activities include pleasure walking, climbing stairs, gardening, yard work, moderate-to-heavy housework, dancing and home exercise.
- More vigorous aerobic activities, such as brisk walking, running, swimming, bicycling, roller skating and jumping rope — done three or four times a week for 30-60 minutes — are best for improving the fitness of the heart and lungs.

## The Benefits of Daily Physical Activity

- Reduces the risk of heart disease by improving blood circulation throughout the body.
- Keeps weight under control.
- Improves blood cholesterol levels.
- Prevents and manages high blood pressure.
- Prevents bone loss.
- Boosts energy level.
- Helps manage stress.
- Releases tension.
- Improves the ability to fall asleep quickly and sleep well.
- Improves self-image.
- Counters anxiety and depression and increases enthusiasm and optimism.

## More Benefits of Daily Physical Activity

- Increases muscle strength, giving greater capacity for other physical activities.
- Provides a way to share an activity with family and friends.
- Establishes good heart-healthy habits in children and counters the conditions (obesity, high blood pressure, poor cholesterol levels, poor lifestyle habits, etc.) that lead to heart attack and stroke later in life.
- In older people, helps delay or prevent chronic illnesses and diseases associated with aging and maintains quality of life and independence longer.

# Appendix D

Locus of Causality for Exercise Questionnaire

Please read each of the statements below and indicate how much you agree or disagree with each statement by circling the appropriate response.

**Exercise = structured or unstructured physical activity, such as running, walking, sports, garden or yard work, and heavy housecleaning.**

**Use the following response categories.**

**Strongly disagree Disagree Moderately disagree Moderately agree Agree Strongly Agree**

| (SD) | (D) | (MD) | (MA) | (A) | (SA) |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

| | SD | D | MD | MA | A | SA |
|---|---|---|---|---|---|---|
| 1. I exercise because I like to rather than because I feel I have to. | 1 | 2 | 3 | 4 | 5 | 6 |
| 2. Exercising is not necessarily something I would choose to do, rather it is something that I feel I ought to do. | 1 | 2 | 3 | 4 | 5 | 6 |
| 3. Having to exercise is a bit of an inconvenience, but it has to be done. | 1 | 2 | 3 | 4 | 5 | 6 |

Perceptions of Competence Questionnaire

These are statements that allow people to describe themselves. There are no right or wrong answers since people differ a lot. Please read the entire statement across.

**First decide which one of the two parts of each statement best describes you.**

***EXAMPLE***

*describes me*

[ ] [ ] Some people really like to go to the movies **BUT** Others don't really like to go to the movies [ ] [ ]

**Then, go to that side of the statement and check the box that describes whether that part is "really true" or "sort of true" FOR YOU. You will just check ONE if the four boxes for each statement.**

***EXAMPLE***

| Really True For Me | Sort of True For Me | | | Sort of True For Me | Really True For Me |
|---|---|---|---|---|---|
| [ ] | [ ] | Some people really like to go to the movies **BUT** | Others don't really like to go to the movies | [ ] | [ X ] |

**REMEMBER to check only ONE of the four boxes for each question**

**For each statement, exercise = structured or unstructured physical activity, such as running, walking, sports, garden or yard work, and heavy housecleaning.**

| | Really True For Me | Sort of True For Me | | | Sort of True For Me | Really True For Me |
|---|---|---|---|---|---|---|
| 1. | [ ] | [ ] | Some people feel that they are not very good when it comes to exercise | **BUT** | Others feel that they are really good at just about every type of exercise | [ ] [ ] |
| 2. | [ ] | [ ] | Some people feel that they are among the best when it comes to exercise ability | **BUT** | Others feel that they are not among the most able when it comes to exercise ability | [ ] [ ] |
| 3. | [ ] | [ ] | Some people are not quite so confident when it comes to taking part in exercise | **BUT** | Others are among the most confident when it comes to taking part in exercise | [ ] [ ] |

**PLEASE COMPLETE FRONT AND BACK OF EACH SHEET**

| | Really True For Me | Sort of True For Me | | | | Really True For Me | Sort of True For Me |
|---|---|---|---|---|---|---|---|
| 4. | [ ] | [ ] | Some people feel that they are always one of the best when it comes to joining in exercise activities | **BUT** | Others feel that they are not one of the best when it comes to joining in exercise activities | [ ] | [ ] |
| 5. | [ ] | [ ] | Some people are sometimes a little slower than most when it comes to learning new skills in an exercise situation | **BUT** | Others have always seemed to be the quickest when it comes to learning new exercise skills | [ ] | [ ] |
| 6. | [ ] | [ ] | Given the chance, some people are always one of the first to join in exercise activities | **BUT** | Other people sometimes hold back and are not usually among the first to join in exercise activities | [ ] | [ ] |

**PLEASE COMPLETE FRONT AND BACK OF EACH SHEET**

**Friend and Family Social Support for Exercise Questionnaire**

Please read each item and indicate the degree to which each has occurred in the past month.

**For each item, <u>exercise</u> = structured or unstructured physical activity, such as running, walking, sports, garden or yard work, and heavy housecleaning.**

---

1. I have a friend or acquaintance who exercised with me.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

2. I have a friend or acquaintance who offered to exercise with me.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

3. I have a friend or acquaintance who gave me helpful reminders to exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

4. I have a friend or acquaintance who gave me encouragement to stick with my exercise program.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

5. I have a friend or acquaintance who changed their schedule so we could exercise together.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

6. I have a friend or acquaintance who planned for exercise on recreational outings.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

7. I have a friend or acquaintance who discussed exercise with me.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

8. I have a friend or acquaintance who talked about how much they like to exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

9. I have a friend or acquaintance who helped plan activities around my exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

10. I have a friend or acquaintance who asked me for ideas on how they can get more exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

11. I have a friend or acquaintance who took over chores so I had more time to exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

12. I have a friend or acquaintance who made positive comments about my physical appearance.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

13. I have a family member who exercised with me.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

14. I have a family member who gave me encouragement to stick with my exercise program.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

15. I have a family member who changed their schedule so we could exercise together.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

16. I have a family member who offered to exercise with me.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

17. I have a family member who gave me helpful reminders to exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

18. I have a family member who planned for exercise on recreational outings.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

19. I have a family member who discussed exercise with me.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

20. I have a family member who talked about how much they like to exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

21. I have a family member who helped plan activities around my exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

22. I have a family member who asked me for ideas on how they can get more exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

23. I have a family member who took over chores so I had more time to exercise.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

24. I have a family member who made positive comments about my physical appearance.

| Never | Hardly ever | Sometimes | Often | Very Often |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

Exercise Motivation Scale

**Why are you currently participating in exercise or physical activity?**

**Directions:** For each of the statements below, please **respond in answer to the above question**. Please read each of the statements and indicate how strongly you agree or disagree with each statement by **circling** the number of the appropriate response to the right of the statement. **Use the following response categories:**

| **Strongly disagree (SD) 1** | **Disagree (D) 2** | **Moderately disagree (MD) 3** | **Moderately agree (MA) 4** | **Agree (A) 5** | **Strongly Agree (SA) 6** |
|---|---|---|---|---|---|

| | SD | D | MD | MA | A | SA |
|---|---|---|---|---|---|---|
| 1. For the pleasure it gives me to experience positive sensations from the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 2. For the satisfaction it gives me to increase my knowledge about the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 3. Because other people believe that it's a good idea for me to be physically active. | 1 | 2 | 3 | 4 | 5 | 6 |
| 4. Because I must be physically active to feel good about myself. | 1 | 2 | 3 | 4 | 5 | 6 |
| 5. Because I believe that regular physical activity is a good way to enhance my overall development. | 1 | 2 | 3 | 4 | 5 | 6 |
| 6. Because it is consistent with what I value. | 1 | 2 | 3 | 4 | 5 | 6 |
| 7. I can't understand why I am doing it. | 1 | 2 | 3 | 4 | 5 | 6 |
| 8. Because I feel pressure from others to participate. | 1 | 2 | 3 | 4 | 5 | 6 |
| 9. Because I think that physical activity allows me to feel better about myself. | 1 | 2 | 3 | 4 | 5 | 6 |
| 10. For the pleasure I experience while learning about the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. For the satisfaction I feel when I get into the flow of the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 12. Because I feel I have to do it. | 1 | 2 | 3 | 4 | 5 | 6 |

**PLEASE COMPLETE FRONT AND BACK OF EACH SHEET**

**Why are you currently participating in exercise or physical activity?**

| | SD | D | MD | MA | A | SA |
|---|---|---|---|---|---|---|
| 13. To satisfy people who want me to be physically active. | 1 | 2 | 3 | 4 | 5 | 6 |
| 14. Because being physically active is an important aspect of how I perceive myself. | 1 | 2 | 3 | 4 | 5 | 6 |
| 15. For the pleasure of understanding the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 16. I have no idea. | 1 | 2 | 3 | 4 | 5 | 6 |
| 17. For the pleasure of mastering the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 18. Because I think it is a good thing for my personal growth. | 1 | 2 | 3 | 4 | 5 | 6 |
| 19. For the pleasure I experience when I feel completely absorbed in the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 20. For the satisfaction I feel while I try to achieve my personal goals during the course of the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 21. Because I would feel guilty if I did not take the time to do it. | 1 | 2 | 3 | 4 | 5 | 6 |
| 22. Because I value the way physical activity allows me to make changes in my life. | 1 | 2 | 3 | 4 | 5 | 6 |
| 23. It is not clear to me anymore. | 1 | 2 | 3 | 4 | 5 | 6 |
| 24. Because I think physical activity contributes to my health. | 1 | 2 | 3 | 4 | 5 | 6 |
| 25. To meet with expectations of others (for example; friends or family). | 1 | 2 | 3 | 4 | 5 | 6 |
| 26. For the enjoyment that comes from how good it feels to do the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 27. Because I enjoy the feelings of discovering more about the activity. | 1 | 2 | 3 | 4 | 5 | 6 |

**PLEASE COMPLETE FRONT AND BACK OF EACH SHEET**

**Why are you currently participating in exercise or physical activity?**

| | SD | D | MD | MA | A | SA |
|---|---|---|---|---|---|---|
| 28. Because I enjoy the feelings of improving through participating in the activity. | 1 | 2 | 3 | 4 | 5 | 6 |
| 29. Because I feel the changes that are taking place through physical activity are becoming part of me. | 1 | 2 | 3 | 4 | 5 | 6 |
| 30. For the pleasure I experience while try to become the person I want to be. | 1 | 2 | 3 | 4 | 5 | 6 |
| 31. Because I would feel ashamed if I was not doing anything to improve my current situation. | 1 | 2 | 3 | 4 | 5 | 6 |

## Leisure Time Exercise Questionnaire

Considering a **7-Day period** (week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your **free time** (write on each line the appropriate number).

"EXERCISE" = structured or unstructured physical activity, such as running, walking, sports, garden or yard work, heavy housecleaning

*EXAMPLE*

**If you ran three times this past week for 45 minutes and did yard work and gardening for 3 hours on Sunday, you would respond as follows: Strenuous = 3; Moderate = 1, and Mild = 0).**

**Times Per Week**

A. **STRENUOUS EXERCISE**
**(HEART BEATS RAPIDLY)**
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, etc.) _____

B. **MODERATE EXERCISE**
**(NOT EXHAUSTING)**
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing, etc.)
_____

C. **MILD EXERCISE**
**(MINIMAL EFFORT)**
(e.g., yoga, archery, fishing from a river bank, bowling, horseshoes, golf, snow-mobiling, easy walking, etc.) _____

7-day Physical Activity Recall Questionnaire

---

During the last seven days, how much total time did you spend doing VIGOROUS physical activity and MODERATE physical activity? Record only time actually engaged in the activity (ignore breaks, rest periods, etc.). Please do not record any LIGHT physical activity (office work, light housework, very light sports such as bowling, or any activities involving sitting).

"activity" = structured or unstructured physical activity, such as running, walking, sports, garden or yard work, heavy housecleaning

| | **Total hours for last 7 days to nearest .5 hours** |
|---|---|
| **VIGOROUS ACTIVITY** (jogging or running, Swimming, strenuous sports such as singles tennis or racquetball, digging in the garden, chopping wood, brisk walking, etc.) | _____ |
| **MODERATE ACTIVITY** (sports such as golf or doubles tennis, yard work, heavy housecleaning, bicycling on level ground, brisk walking, etc.) | _____ |

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# Appendix E

## Expert Evaluation of Intervention Printed Materials

Based on expert reviewers' feedback several cosmetic and phrasing modifications to the original intervention materials were made. A general summary of the reviewers' evaluative comments follows.

1. All three reviewers felt the strategies used in the intervention were self-determination appropriate.
2. Two reviewers suggested moving the social support section closer to the front. This modification was made.
3. One reviewer suggested the inclusion of an example of coping with relapse to sedentary behavior. This modification was made.
4. All reviewers felt that the elements of autonomy support, competence, and relatedness were addressed in the intervention.
5. All reviewers felt the materials were easy to understand and appropriate for the intended audience.

Evaluation of Intervention Printed Materials by

Fitness Professionals and Walking Class

| Quality | Fitness Professionals (N = 2) | | Walking Class (N = 24) | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| Vague or confusing? | 0 | 2 | 1 | 23 |
| Inaccurate or misleading? | 0 | 2 | 0 | 24 |
| Important points omitted? | 0 | 2 | 3 | 21 |
| Anything offensive? | 0 | 2 | 0 | 24 |

| | Fitness Professionals (N = 2) | | | Walking Class (N = 24) | | |
|---|---|---|---|---|---|---|
| | Very | Somewhat | Not Particularly | Very | Somewhat | Not Particularly |
| Realistic? | 2 | 0 | 0 | 14 | 10 | 0 |
| Understandable? | 2 | 0 | 0 | 22 | 2 | 0 |
| Appealing? | 0 | 2 | 0 | 16 | 8 | 0 |
| Encouraging? | 2 | 0 | 0 | 15 | 9 | 0 |
| Motivating? | 1 | 1 | 0 | 11 | 13 | 0 |

How responsive will audience be to suggestions in packet?

| Fitness Professionals (N = 2) | | | Walking Class (N = 24) | | |
|---|---|---|---|---|---|
| Very | Somewhat | Not at all | Very | Somewhat | Not at all |
| 2 | 0 | 0 | 8 | 16 | 0 |

# Appendix F

Comparison of Intervention and AHA Printed Materials

| Characteristic | ON THE MOVE | AHA FACTS |
|---|---|---|
| Information regarding benefits of exercise | YES | YES |
| Strategies to remember reasons for being active | YES | NO |
| Strategies to increase activity | YES | NO |
| Strategies for choosing activities in which to participate | YES | NO |
| Strategies for scheduling exercise into routine | YES | NO |
| Strategies for sticking to exercise plan | YES | NO |
| Strategies for coping with relapse to sedentary behavior | YES | NO |
| Strategies for seeking support for exercise behavior | YES | NO |
| Statistics of Americans' participation patterns | NO | YES |

# Appendix G

## Extended Literature Review

### Current Physical Activity Status of Americans

There remains little doubt regarding the physiological and psychological health benefits of regular exercise and physical activity. Both have been associated with decreased risk of cardiovascular disease, non-insulin dependent diabetes, colon cancer, anxiety, and depression (Pate et al., 1995). The American College of Sports Medicine (ACSM) most recently recommended that adults accumulate 30 minutes of moderate intensity physical activity at least five days a week in order to realize the associated health benefits (ACSM, 2000). Current estimates indicate that too few Americans engage in these behaviors at the levels necessary to realize the associated health benefits (US Department of Health and Human Services, USDHSS, 2000). Approximately 15% of adults in the United States currently report engaging in moderate levels of physical activity for 30 minutes or more five or more days per week, while 23% do not engage in any physical activity (USDHHS, 2000). Clearly, the knowledge of health benefits alone has not been enough to get people moving.

### Intrinsic and Extrinsic Motivation and Exercise Behavior

Recent investigations suggest the importance of motivational factors in determining the adoption and maintenance of exercise behaviors (Markland, 1999; Mullan & Markland, 1997). In particular, the influence of intrinsic and extrinsic motivation has been explored. Intrinsic motivation refers to "the inherent tendency

to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn" (Ryan & Deci, 2000b, p. 70). With regards to behavior, the construct more generally refers to performing an activity for the inherent pleasure and satisfaction of the activity itself. In contrast, extrinsic motivation refers to performing an activity for some outcome separable from the activity (Ryan & Deci, 2000a). That is, the activity holds some instrumental value. Historically, these two constructs have been viewed dichotomously, and the relationship of one or both to sport and exercise behaviors has been examined from several theoretical perspectives, including competence motivation theory (Harter, 1981), self-efficacy theory (Bandura, 1986), and cognitive evaluation theory (Deci & Ryan, 1985a). While intrinsic motivation has been viewed as more desirable, and associated with positive psychological and behavioral outcomes, extrinsic motivation, while powerful, has more typically been portrayed as a more impoverished form of motivation (Ryan & Deci, 2000a), associated with less positive long-term outcomes.

Cognitive evaluation theory (CET, Deci & Ryan, 1985a), a subtheory of self-determination theory (SDT, Deci & Ryan, 1985a), has received considerable attention in explaining social factors that influence intrinsic motivation in sport contexts. CET suggests that events, such as feedback and rewards, that increase perceptions of competence and a sense of autonomy, or internal perceived locus of causality (deCharms, 1968), will enhance intrinsic motivation (Ryan & Deci, 2000a). An internal perceived locus of causality refers to the belief that one is the

origin of ones' own actions (deCharms) rather than having a sense of being controlled.

Within the framework of CET, researchers have investigated the influence of rewards, feedback, and competitive structures on individuals' levels of intrinsic motivation. Initial investigations demonstrated that rewards for tasks that are already interesting diminished intrinsic motivation (Calder & Straw, 1975; Orlick & Mosher, 1978) due to their controlling influence, while feedback from coaches providing information and encouragement has been found to increase perceptions of competence (Horn, 1985). Early studies also indicated that events perceived as controlling, such as the receipt of scholarships, decreased intrinsic motivation (Ryan, 1977, 1980). More recently, a meta-analysis of studies supported the undermining effect of extrinsic rewards on intrinsically motivated behaviors (Deci, Koestner, & Ryan, 1999). The role of informational and encouraging feedback from coaches in increasing intrinsic motivation has also been supported (Amorose & Horn, 2000). Amorose and Horn re-examined the relationship between scholarship status and intrinsic motivation in a sample of college scholarship and non-scholarship male ($n$=199) and female ($n$=187) college athletes. Unlike E. Ryan (1977), they found that the scholarship athletes reported higher levels of intrinsic motivation than non-scholarship athletes, however, perceptions of coaching behaviors had a greater influence on intrinsic motivation than scholarship status. Specifically, higher levels of intrinsic motivation were reported by athletes who perceived their coaches as having more democratic than autocratic leadership

styles, and who responded to athletes with more encouragement, praise, and informational feedback. These findings align with the predictions of CET, in that a democratic style is associated with greater autonomy and less control, and encouragement, praise, and informational feedback are associated with enhanced perceptions of competence.

Competitive structures that emphasize winning at all costs versus recreational sport structures have also been associated with lower levels of intrinsic motivation (Fortier, Vallerand, Briere, & Provencher, 1995). In general, then, the contentions of CET have been supported in the sport domain, in that higher levels of intrinsic motivation have been associated with contexts that provide greater perceptions of choice and less control and events that provide information leading to positive perceptions of competence.

A basic tenet of CET, however, it is that intrinsic motivation will only occur for those activities or behaviors that hold some type of intrinsic interest or appeal for the individual (Ryan & Deci, 2000a). Activities lacking this characteristic, then, may be inadequately addressed through an understanding of intrinsic motivation. Exercise is certainly one behavior that may be categorized by many as less than inherently interesting and appealing. It should, therefore, be no surprise that the adoption and maintenance of such behaviors cannot fully be explained by focusing on intrinsic motivation alone. Thus, to explain exercise behaviors, it may be more useful to understand the nature of extrinsic motivation.

Self-determination Theory

Self-determination theory (SDT, Deci & Ryan, 1985a), under which CET is subsumed, proposes that extrinsic motivation is not a unitary concept, but rather, has different forms. SDT proposes that extrinsic motivation can vary in the degree of autonomy or self-determination with which it is associated. Hence, individuals who engage in an activity for its instrumental value, may do so based on different levels of autonomy (Ryan & Deci, 2000a). For example, one individual may exercise three times a week because her doctor has told her that exercise will help control her blood pressure, and she, therefore, exercises because she feels she should. A second individual may exercise three times a week because she values being a healthy individual, and believes that exercise is an important component of health maintenance. Both individuals exercise for extrinsic instrumental reasons, however, the first individuals does so due to internalized external pressures, while the second individual does so because of endorsement of the activity in meeting personal goals. These two examples represent different levels of internalization of behavioral regulation, and correspond to different types of extrinsic motivation, which SDT suggests lie on a continuum of motivation.

SDT further suggests that individuals will move along a continuum ranging from amotivation, representing no intention or regulation of behavior, to intrinsic motivation, the prototype of self-determined regulation. Between these distal points on the continuum lie the different types of extrinsic motivation ranging from the least to the most autonomous, or self-determined, form. This simplex pattern of

relationships along a continuum has been supported in the literature (Li, 1999; Ryan & Connell, 1989, O'Connor & Vallerand, 1994b). Movement along the continuum is associated with increasingly positive psychological and behavioral outcomes (Deci & Ryan, 1985b).

Amotivation sits at the far end of the continuum. In this state, the individual is not motivated towards the behavior. As such, amotivation represents a lack of intention to act (Ryan & Deci, 2000b). Individuals will either not engage in an activity at all, or will do so with no sense of why they are engaging in the activity.

The least autonomous form of extrinsic motivation is represented by external regulation. Behaviors are performed due to a sense of external control or pressure, or to receive an external reward. Typically individuals will perform such activities experiencing a sense of external pressure (Ryan & Deci, 2000a). For example, the exerciser in our previous example may exercise because she fears sanctions from her doctor if she does not, and hence, experiences a sense of external control over her behavior.

The next type of extrinsic motivation on the continuum is represented by introjected regulation. In this state, the individual has introjected, or internalized without endorsement, the external control. Thus, behavior is performed because one feels one "should," and the individual experiences little sense of autonomy with regards to the behavior. In this case, an individual may exercise because she has internalized the external pressure from her doctor, and may do so to avoid feeling guilt or anxiety.

As individuals become more self-determined in the internalization of behavioral regulation, a third type of extrinsic motivation is represented by identified regulation. The individual performs a behavior because he or she has identified the behavior as highly valuable and personally important (Ryan & Deci, 2000b). With regard to the previous example, an individual now chooses to exercise because she values being healthy and associates exercise with that goal.

The most self-determined form of extrinsic motivation is represented by integrated regulation. Here, the individual is said to have fully assimilated the identified regulation into the self, and has brought these behavioral regulations in congruence with other needs and values (Ryan & Deci, 2000a). Our exerciser, then, exercises because she believes herself to be a fit and healthy individual, and exercise is a component of that self-perception. SDT contends that while motivated behavior resulting from integrated regulation shares many qualities with intrinsic motivation, it is still extrinsic due to its instrumental nature. While representing a highly autonomous form of behavior, behavior motivated by integrated regulation is still performed due to outcomes (e.g., being fit or healthy) that are separate from the behavior (e.g., exercise) itself.

Finally, the prototype of self-determination is intrinsic motivation (Ryan & Deci, 2000b), and sits at the far end of the continuum. Here, behavior is engaged in for its inherent pleasure. Vallerand and colleagues (Vallerand et al., 1993) described three types of intrinsic motivation: intrinsic motivation to know, to accomplish, and to experience stimulation. Intrinsic motivation to know is related

to the pleasure and satisfaction associated with learning or exploring a new task. Intrinsic motivation to accomplish refers to the satisfaction associated with mastery of a task, similar to effectance motivation (White, 1959). Intrinsic motivation to experience stimulation is related the experience of pleasant sensations associated with engagement in a task (Vallerand, 1997).

SDT further suggests that social factors will facilitate or inhibit movement along the continuum towards more self-determined regulation of behavior. Specifically, these factors encompass what SDT proposes as three basic human psychological needs: the need for autonomy, the need for competence, and the need for relatedness. As such, facilitation of those social conditions that promote integration and assimilation, allowing such tendencies to express themselves, is linked to congruence of the self, whereas contexts that depress the expression of these tendencies will lead to fragmentation and alienation of the self (Ryan, 1995). In other words, factors nurturing these psychological needs will lead to greater internalization of behavioral regulation, and more self-determined or autonomous behavior. This tenet of SDT is particularly useful in understanding how initially unappealing or uninteresting behaviors, such as exercise or physical activity, may be increasingly internalized, gain greater endorsement of self, and ultimately be associated with positive outcomes, such as more positive affect and persistence.

Organismic integration theory (Deci & Ryan, 1985, Ryan & Deci, 2000b), a second subtheory of SDT, describes this process of internalization and integration and, importantly, explains how individuals become more self-determined and

autonomous, rather than controlled in their behaviors. Contexts that promote support for self-determination foster the organismic integrative process leading to integration of behavioral regulation, while those contexts that do not support self-determination may lead only to introjection of behavioral regulation. Specifically, contexts that promote autonomy support, perceptions of competence, and a sense of relatedness will facilitate the integration of behavioral regulation (Ryan & Deci). Autonomy support is fostered in contexts that provide choice, minimize pressure to perform in certain ways, and encourage personal initiation of behavior. Contexts within which behavior-outcome contingencies are clear and informational feedback is provided will promote perceptions of competence. Finally, contexts that promote involvement and interest from significant others will promote a sense of relatedness (Deci & Ryan, 1991). Thus, when these three dimensions of the social context are optimized, individuals should be more able to satisfy the three basic psychological needs, leading to greater self-determined behavior. While each of the dimensions of support will promote internalization of behavioral regulation, SDT suggests that the fostering of autonomy support is most critical in the integration of regulation, and that the promotion of competence and relatedness in the absence of autonomy support may lead only to introjected motivation (Ryan & Deci, 2000b). For individuals to truly integrate regulations into their own system of values and goals they must do so with a sense of volition and freedom from pressure and control (Ryan & Deci).

The theoretical relationships among psychological needs, internalization of behavioral regulation, and behavioral and psychological outcomes proposed by SDT have been explored in educational contexts (Black & Deci, 2000; Boggiano, Flink, Shields, Seelbach, & Barrett, 1993; Miserandino, 1996), health-care settings (Kasser & Ryan, 1999; O'Connor & Vallerand, 1994a), and in treatment for chemical dependency (Foote et al., 1999). Several studies particularly attest to the utility of SDT in explaining and predicting behaviors in each of these contexts.

For example, individuals in a weight-loss program who reported more self-determined program behavior regulation, attended the program more regularly, lost more weight, and maintained their weight loss to a greater degree than those with less autonomous reasons for attending the program (Williams, Grow, Freedman, Ryan, & Deci, 1996). Perceptions of physicians' autonomy support influenced adherence to long-term medication regimens in adult outpatients (Williams, Rodin, Ryan, Grolnick, & Deci, 1998). Moreover, the patients' self-determined motivation mediated the relationship between perceptions of autonomy support and adherence.

Perhaps the most extensive investigation of motivation using SDT has occurred in the academic domain. For example, identified regulation has been associated with more interest and enjoyment of school, greater effort, and more positive coping styles, than external or introjected regulation in elementary school children (Ryan & Connell, 1989). College students who dropped a course reported lower levels of intrinsic and identified regulation and higher levels of amotivation than those students who persisted in the course (Vallerand & Bissonnette, 1992). A

sequential model was tested in which perceptions of autonomy, competence, and relatedness influenced motivation, which then influenced behavior. High school students' perceived competence and perceptions of academic autonomy influenced academic motivation which then influenced school performance in the pattern suggested by SDT (Fortier, Vallerand, & Guay, 1995).

Influence of Social Contexts on Behavioral Regulation and Behavior

More recently, the academic motivational model has been expanded to include the influence of social contexts (Vallerand, 1997). The behavior of teachers, parents, and school administrators influenced high school students' perceptions of competence and autonomy, which, in turn led to behavior (Vallerand, Fortier, & Guay, 1997). Specifically, the less autonomy supportive the behavior of teachers, parents, and administrators, the lower students' perceptions of competence and autonomy. Low levels of perceived competence and autonomy led to less self-determined academic motivation, which then led to greater intention to drop out of high school and then actual dropout behavior (Vallerand et al.). While receiving less attention in the literature, greater internalization of positive school behaviors occurred in children who reported feeling more cared for and connected to parents and teachers than children with lower levels of internalized regulation (Ryan, Stiller, & Lynch, 1994), supporting the contextual influence of relatedness.

Of particular interest are several studies in which the controlling strategies of teachers were experimentally manipulated. Flink and colleagues found that 4$^{th}$

grade students (N = 267) who were taught by teachers trained to teach in a pressure and non-pressure manner showed differential performance and motivation for anagram, picture sequencing, and spatial relations tasks. Students were instructed in completion of the anagram and picture sequencing by either a pressure condition teacher or a non-pressure condition teacher and then asked to complete the anagram, picture sequencing, and an untaught spatial relations task after the teacher had left. For all three tasks, students taught by the non-pressure teachers performed significantly better than those taught by the pressuring teachers (Flink, Boggiano, & Barrett, 1990).

Two studies examined the effect of manipulated controlling strategies and restricted choice on college students' performance on analytic problem-solving tasks (Boggiano et al., 1993). In one study, thirty-four college students were randomly assigned to be taught to solve analytic reasoning problems in either a controlling manner or non-controlling manner. In both conditions the investigator taught a method for solving the problems. In the controlling condition, an investigator read an instructional script that emphasized how the problems *should* be approached. In the non-controlling condition, the same investigator presented instructions that emphasized the students' choice in selecting the method that worked best for them to solve the problems. Students in the controlling condition reported significantly lower feelings of freedom regarding task regulation than students in the non-controlling condition. In a second study Boggiano et al. (1993) repeated the procedures from the first study with 83 college students, and examined

students' subsequent performance. Results indicated that students taught in the controlling condition performed significantly worse than those students taught in the non-controlling condition.

Deci, Eghrari, Patrick, and Leone (1994) found that internalization of behavioral regulation was facilitated by providing a rationale for behavior, providing empathy for the individual, and providing a sense of choice. In a laboratory setting, each of the three contextual factors was manipulated as participants engaged in an uninteresting computer-assisted tracking task. Results indicated that internalization was significantly higher for participants provided with two or three facilitating contextual factors, than for those receiving zero or one facilitating factor. Additionally, the authors reported positive correlations between behavioral and self-report measures of internalization for those receiving at least two facilitating contextual cues, indicating integration of behavioral regulations. In contrast, negative correlations between behavioral and self-report measures of internalization were found for those receiving zero or one facilitating contextual cues, indicating introjection of behavioral regulation. Thus, the same behavior (as measured by free time spent in activity engagement) was regulated differently, depending on the presence of contextual factors promoting self-determination. Together, these studies provide further support for both the suggested SDT relationships, and the viability of social context manipulation.

Self-determination and Exercise Behaviors

The relationships suggested by SDT have also been examined in exercise contexts, with greater levels of internalization associated with greater frequency of exercise (Li, 1999) and persistence (Mullan & Markland, 1997). More self-determined motives for participation in exercise have also been associated with greater adherence (Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997) and greater levels of intrinsic motivation (Markland, 1999).

Mullan and Markland (1997) found that self-determined regulation of exercise behavior increased across the stages of exercise behavior proposed by the transtheoretical model (Prochaska & Marcus, 1994). Male ($n$ = 158) and female ($n$ = 156) community residents completed self-report measures of behavioral regulation in exercise and stage of exercise behavior. Discriminant function analyses revealed that 87.85% and 90.85% of the variance in stage of change was accounted for by discriminant functions in which identified regulation and intrinsic motivation made the greatest contribution for males and females, respectively. Furthermore, individuals who were in the action and maintenance stages of exercise behavior (regularly exercise for less than 6 months, and 6 months or more, respectively) reported greater degrees of internalized exercise behavior regulation than those in the preparation stage of exercise behavior (starting to make moves toward regular exercise). Those in preparation reported greater degrees of internalization than those in a combined precontemplation and contemplation stage (not even thinking of exercising and contemplating exercise in the near future).

Thus, the hypothesis that self-determination in the regulation of exercise behavior increases across stage of change, suggested by SDT, was supported. However, as the authors acknowledge, due to the cross-sectional design directionality of effect is unclear. That is, it is unknown whether those who were more self-determined were better able to reach the later stages of exercise behavior, or if those in the later stages became more self-determined.

To clarify, in a prospective design, similar findings were reported over a 3-month period (Ingledew, Markland, & Medley, 1998). British government employees completed measures of exercise behavioral regulation and stage of exercise behavior at baseline ($\underline{N}$ = 425) and after 3 months ($\underline{N}$ = 247). Investigators classified participants by their movement or lack of movement across stage over the 3-month period, resulting in categories representing those who remained inactive, remained active, became active, or became inactive. Results suggested that those with extrinsic motives for participation tended to remain in the early stages, while those who became and maintained exercise behaviors reported more intrinsic motives for participation.

Li (1999) found a positive relationship between level of exercise behavior regulation and exercise behavior, in the development of a measure of exercise motivation based on SDT. In a series of studies Li was able to demonstrate construct and factorial validity for eight subscales representing the three forms of intrinsic motivation suggested by Vallerand et al. (1992), the four forms of extrinsic motivation, and amotivation. Moreover, Li found support for the

relationships among perceptions of autonomy, competence, relatedness, and exercise behavior regulation suggested by SDT, in a group of university students (N = 598) enrolled in physical activity classes. Significant positive relationships were found between perceived autonomy and relatedness and the three intrinsic motivations, and integrated and identified regulations. Significant positive relationships were also found between perceptions of competence and the three intrinsic motivations. Negative relationships were found between perceived autonomy and relatedness and amotivation and external regulation, and between perceived competence and amotivation. Thus, the association of social context to exercise behavior regulation was generally supported.

The relationship of contextual factors to perceived competence, self-determination, intrinsic motivation, and effort and persistence has been examined in physical education contexts (Ferrer-Caja & Weiss, 2000). High school students (N = 407) reported teacher's level of non-directiveness, perceptions of choice, and intrinsic motivation. Teachers reported students' level of effort and persistence in physical education class. Within the model tested by the authors, teacher's non-directiveness had a significant positive influence on self-determination, represented by perceptions of choice, which positively influenced intrinsic motivation, which then positively influenced effort and persistence. While the behaviors examined in this study were physical education skills, and not specifically exercise behaviors, the findings of the study do attest to the pattern of SDT relationships and the sequential model proposed by Vallerand and colleagues (1997).

The potential for manipulation of social context has been explored with regard to choice of music in aerobic workout tapes (Dwyer, 1995). Twenty-four females (mean age = 27.4 years) were randomly divided into two groups. One group was asked to indicate the extent to which they would like to hear each of 12 songs on a 5-point Likert-type scale ranging from 1 = not like to hear to 5 = like to hear. The other group was not asked to express music preference. Aerobic videotapes containing seven of the 12 songs had been created for the study, independent of the first group's expressed preferences. Each study participant worked out to the videocassette for 25 minutes, in private, and then completed an aerobic version of the Intrinsic Motivation Inventory (McAuley, 1991) and an assessment of perceived choice of music. Results revealed that those in the choice group reported significantly greater interest/enjoyment, perceived competence, effort/importance, and total intrinsic motivation than those in the control group. Additionally, those in the choice group reported significantly greater perceptions of choice than those in the control group. These findings provide support for the relationship of autonomy support to intrinsic motivation, and that context may be associated to perceptions of autonomy support. As no measures of intrinsic motivation or perceptions of choice were administered at baseline, the direction of the relationships is unclear. The study does suggest, however, the potential for successful intervention and manipulation of contextual factors in the physical domain.

Mediated Interventions in the Physical Domain

Interventions in the physical domain have demonstrated varying degrees of success (Sallis & Owen, 1999). Dishman and Buckworth (1996) conducted a meta-analysis of 127 physical activity interventions and found that the greatest effect size (.92) resulted from interventions using some type of behavior modification. Furthermore, and perhaps surprisingly, mediated interventions (i.e., mail, mass-media, or telephone based) had a greater effect size (.91) than face-to-face (.10) or some combination of face-to-face and mediated (.16) interventions.

Cardinal and Sachs (1996) significantly increased exercise behaviors after 31 days in participants who received a lifestyle exercise behavior packet of printed materials in the mail. One hundred thirteen female clerical workers were classified by the transtheoretical model's stage of exercise behavior and then randomly assigned to receive either a lifestyle exercise packet, structured exercise packet, or control packet in the mail. Both the lifestyle and structured exercise packets were seven pages in length, included a health status report, and were tailored to the participants' reported stage of exercise and offered encouragement for increasing lifestyle physical activity or structured exercise, respectively. Those in the control group received an informational packet containing only, a report of their health status, predicted $VO_{2\,max}$, and predicted body fat percentage, derived from biometric data collected at baseline. After 1 month, all groups reported significant increases in exercise behaviors, with the greatest within group effect sizes found in the lifestyle and structured groups. While no significant differences in exercise

behavior were found between those in the structured and lifestyle groups, those who had received the lifestyle packets reported significantly greater exercise behavior than those in the control group. These findings suggest the potential of mail-mediated systems as vehicles for promoting both lifestyle and structured exercise behaviors.

Similar results using mail-mediated written materials have been reported with community participants after six weeks (Marcus et al., 1992). As part of a community-wide campaign to increase exercise behavior, 610 adults (mean age = 41.8 years) were mailed written materials promoting exercise behavior. Based on initial classification by stage of exercise behavior, participants received one of three four-page printed packets in the mail. The packets were based on both the general exercise adoption and adherence, and stage of change literature. After six weeks, responses from 236 of the participants were obtained via telephone contact, to assess post-intervention exercise behaviors. The authors report that no significant differences in original stage classification distinguished this group from those who were not contacted. Results indicated that participants were significantly more active after the six-week intervention period than at baseline. The greatest increases were evidenced in those who had been initially classified in the preparation stage, in that 61.3% of those individuals reported advancing to the next stage (action) of exercise behavior. While this study is limited by both the lack of a control group, and the fact that only 38.8% of the initial sample was available for analysis, the findings do support the use of mail-mediated interventions in promoting exercise

behaviors. Additionally, in this case, the effect of the intervention was greatest on those in the preparation stage, supporting the use of this group as a target for future intervention efforts.

Stage of change movement after the delivery of mail-mediated, stage of change tailored intervention materials has also been demonstrated after a 3-month period (Marcus, Emmons, Simkin-Silverman, Linnan, Taylor, & Bock, 1998). Participants were members of 11 community worksites participating in a larger community wellness program. Participants were randomly assigned to either a stage of change tailored intervention group, or a standard self-help group. Those in the tailored intervention group were initially mailed stage-matched materials based on baseline assessment of stage of exercise behavior. After 1 month those in the tailored group were mailed the next, more advanced stage-matched materials. Those in the standard self-help group were mailed two American Heart Association brochures, each at the same time intervals as the tailored intervention group. Physical activity, as measured by self-reported stage and the 7-day Physical Activity Recall (Blair, 1984), was assessed at baseline and 3 months. Of 903 participants completing baseline measures, 656 (72.6%) completed assessments at 3 months. At 3 months participants were classified by their stage of exercise movement. That is, participants were categorized as either regressing in stage, remaining stable in stage, or progressing in stage. Chi-square analysis revealed that a significantly greater number (36.8%) of those in the tailored group progressed than those in the standard group (26.8%), while a greater number of those in the

standard group remained stable (58.4% vs. 52.3%) or regressed in stage (14.7% vs. 10.9%). Of particular interest is the fact that there were no significant increases in physical activity over time for either the tailored intervention group or the control group, as measured by self-reported minutes spent in exercise activity.

It should be acknowledged that some of the strategies developed for the current study contain similar features to the intervention packets used by Cardinal and Sachs (1996) and Marcus and colleagues (1992). All three intervention packets suggest a variety of methods for increasing exercise behaviors and emphasize enjoying oneself. While some similarities exist, the earlier interventions packets were not grounded in SDT.

The use of a booster to an initial mail-mediated intervention designed to increase walking behavior has been explored with a sample of ethnic minority women (Chen et al., 1998). One hundred twenty-five sedentary women (mean age = 36.53 years) of Latin ($n$ = 57), African-American ($n$ = 51), Asian or Pacific Islander ($n$ = 9), and mixed ($n$ = 8) ethnic origin were randomly assigned to a mail-mediated or mail-mediated plus telephone contact group. All participants received a 32-page American Heart Association (AHA) exercise pamphlet and 27-page AHA women and heart disease risk pamphlet. Additionally, participants were mailed a six-page walking kit with instructions on how to implement a walking program in four-steps, and one-page tip sheets targeting overcoming barriers to exercise. Those participants in the enhanced intervention group also received six telephone contacts over the 8-week intervention period. These 20-30 min contacts were designed to

increase self-efficacy and social support for physical activity. After eight weeks both groups reported significantly greater amounts of walking behavior than at baseline, however, no significant differences between the two groups were reported. The authors suggest several explanations for these findings. While the number of calls completed was significantly associated with changes in walking behavior, difficulty in making telephone contact predicted dropout from the study. Difficulties in making telephone contact with participants resulted in an average of 15 telephone calls per participant to complete the six intervention contacts. Additionally, the calls were lengthy (average length = 23.4 min), and the authors suggest that these factors may have been more detrimental, vis a vis attrition from the study, than helpful in increasing walking behavior. Thus, this study provides further support for the efficacy of mail-mediated interventions, and suggests the need for more convenient and expediently delivered boosters to initial interventions.

Together, literature from the academic, health-care, and physical domains supports the theoretical relationships proposed by SDT. Moreover, research in the academic and health-care domains indicate the successful manipulation of social contexts leading to positive behavioral and psychological outcomes. While the theoretical relationships proposed by SDT have been supported in the exercise domain, it remains unclear whether social contexts can be successfully manipulated, and if these manipulations will lead to positive outcomes, such as

increased exercise behaviors. Findings from studies employing mail-mediated interventions suggest the viability of this approach in both increasing physical activity behaviors and manipulating the social contexts of physical activity.