Multi-Phase Mediator Analysis of a Social-Cognitive Church-Based Physical Activity Intervention

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Abstract

This study tested an integrated social cognitive model of physical activity intention formation, onset, and maintenance among sedentary participants ($N = 465$) in a church-based, social cognitive, physical activity intervention. Three separate models were tested via structural equation modeling. Each model provided a good fit to the data. The models explained 28%, 19%, and 9% of the variance in intention formation, physical activity onset, and physical activity maintenance, respectively. Consistent with hypotheses, self-efficacy mediated the effect of positive outcome expectancy on behavioral intention, adoption of behavioral strategies mediated the effect of the intervention on physical activity onset, and maintenance of self-efficacy mediated the effect of the intervention on physical activity maintenance. Contrary to hypotheses, change in self-efficacy from baseline to post-assessment and perceived satisfaction with intervention outcomes did not have effects on physical activity onset or maintenance. The findings provide preliminary evidence that physical activity intention formation, onset, and maintenance are distinct processes driven by different determinants before, during, and following a social cognitive physical activity intervention.

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Sedentary behavior has been identified as one of the leading factors in all-cause mortality and many debilitating diseases (Blair et al., 1989; Mokdad, Marks, Stroup, & Gerberding, 2004). Physical activity interventions have displayed moderate success in promoting short-term increases in physical activity (mean effect of $r = .34$; Dishman & Buckworth, 1996). However, interventions based on social-cognitive models of health behavior have been unsuccessful in changing the variables theorized to mediate change in physical activity behavior (Baranowski, Anderson, & Carmack, 1998). Considering the ability of social cognitive models to explain physical activity (Godin, 1993; McAuley & Courneya, 1993; Rogers & Prentice-Dunn, 1997), interventions based on these models have the potential for even greater success if social cognitive variables can be successfully manipulated. Therefore, it is crucial that large-scale, theoretically based interventions appropriately target social-cognitive variables, and analyze the extent to which these variables mediate behavior change (Baranowski, Anderson, & Carmack, 1998).

One area of particular interest to researchers is how social cognitive variables operate from onset to maintenance (e.g., Marcus et al., 2000). This is especially important given the lack of success in getting participants to maintain active lifestyles once interventions have ended (Dishman & Buckworth, 1996). Indeed, intervention studies often cited as successes in physical activity maintenance, indicate only small and declining effects at follow-up (Dunn, Marcus, Kampert, Garcia, Kohl, & Blair, 1999; Simons-Morton et al., 2001). It has been suggested that this lack of success in physical activity maintenance reflects a dearth of theoretical conceptualization and corresponding empirical research on how social cognitive variables influence physical activity over time (Rothman, 2000). In most social cognitive models, the same processes that are theorized to explain behavior onset are thought to explain behavior maintenance (Ajzen, 1991; Bandura, 1997; Rogers, 1983; Rosenstock; 1966). For example, in self-efficacy theory, self-efficacy and outcome expectancies are theorized to determine physical activity; self-efficacy is posited to determine behavior both directly and through its influence on outcome expectancies (Bandura, 1997). However, there is no theoretical premise as to how these variables interact and contribute to behavior differentially from behavior onset to behavior maintenance. Given our inability to induce maintenance of health behavior (e.g., physical activity) it may be time to reexamine this assumption (Rothman, 2000).

Various stage-based models have attempted to explain how behavior change occurs over time (Weinstein, Rothman, & Sutton, 1998). The transtheoretical model is a widely used stage-based approach to behavior intention, adoption, and maintenance (Prochaska & DiClemente, 1984). According to the transtheoretical model, behavior change follows a series of stages: precontemplation, contemplation, preparation, action, and maintenance (Prochaska & DiClemete, 1984). Movement through the stages is defined by intention formation and consistency and duration of physical activity behavior. Specifically, movement from precontemplation to contemplation occurs when behavioral intentions are formed. Movement from contemplation to preparation occurs when physical activity begins to occur on an irregular basis. When the physical activity occurs more regularly (e.g., 30 minutes per day, 5 days per week) one moves from preparation to action, and when regular physical activity has occurred for 6 months one is said to be in the maintenance stage. A number of factors influence movement through the stages, including cognitive and behavioral processes of change, self-efficacy, and decisional balance. According to the theory, cognitive processes are more important in influencing movement through the early stages, with behavioral processes taking precedence in the action and maintenance stages; however, the theory does not delineate exactly how these processes interact with other variables in the model, such as self-efficacy and decisional balance. Moreover, a meta-analysis of 71 published studies did not support the distinction between cognitive and behavioral processes of change (Marshall & Biddle, 2001).

Another stage-based model, Schwarzer's (1992) health action process approach (HAPA) organizes aspects of social cognitive theory (Bandura, 1997) into motivation and volition stages. Similar to the transtheoretical model, the HAPA proposes different mechanisms of change during intention formation and action. In contrast to the transtheoretical model, the HAPA offers specific formulations of how social cognitive variables interact to influence physical activity in each of these stages. First, in the *motivation stage,* outcome expectancies and self-efficacy determine behavioral intentions. *Behavioral intentions* are similar to proximal goals, and must be formulated before purposeful action can be initiated (Bandura, 1997, Ajzen, 1991). *Self-efficacy*—confidence in the ability to carry out actions necessary to attain goals--is the primary explanatory variable in social cognitive theory (Bandura, 1997) and the most proximal determinant of behavioral intention in the HAPA (Schwarzer, 1992). Prior research has shown that self-efficacy predicts and is positively related to both intentions and onset of physical activity in sedentary adults (for reviews, see Bandura, 1997; Maddux, Brawley, & Boykin, 1995; McAuley & Courneya, 1993; Schwarzer, 1992).

Interventions that target physical activity self-efficacy typically do so by increasing confidence in the ability to overcome barriers to physical activity, such as time constraints and lack of resources. However, those who are initially sedentary must become motivated before they will formulate intentions to be physically active (Schwarzer, 1999). Motivation to engage in physical activity is a function of positive and negative *outcome expectancies*—perceptions of the probability that particular outcomes will occur as a result of certain behaviors (Rotter, 1954). According to the HAPA, outcome expectancies influence behavioral intentions through their impact on self-efficacy. Although social cognitive theory posits that self-efficacy causally precedes outcome expectancies (Bandura, 1997), in the HAPA, outcome expectancies are theorized to determine self-efficacy, because decisions about whether someone can do something is based in part on whether it is deemed worthwhile given the expected outcomes (Schwarzer, 1992; see also Kirsch, 1995). Indeed, it has been shown that increasing expected incentives causes increases in self-efficacy ratings for a snake-handling task (Kirsch, 1982) and smoking cessation (Corcoran & Rutledge, 1989). In the physical activity domain, outcome expectancy and self-efficacy are consistently related, although their causal ordering has not been explored empirically (Williams, Anderson, Winett, in press).

In the motivation phase of the HAPA outcome expectancies and self-efficacy drive intentions to be physical active. However, once individuals are motivated, and intentions have formed, they begin to plan how to carry out and maintain the behavior. Schwarzer refers to this as the *volition stage*. In addition to determining behavioral intentions in the motivation stage, self-efficacy is posited to influence behavioral initiation in the volition stage. However, the HAPA posits that in the volition stage self-efficacy influences behavior partly through its impact on *behavioral strategies* aimed at overcoming barriers to physical activity. Schwarzer (1992) argues that self-efficacy alone cannot produce behavior, but rather self-efficacy determines the number and scope of specific action plans or behavioral strategies to be used to overcome barriers to physical activity. In partial tests of the HAPA self-efficacy and action plans (i.e., behavioral strategies) for breast self-examination and single-occasion drinking have been moderately correlated (r = .38 to .52; Luszczynska & Schwarzer, 2003; Murgraff, McDermott, & Walsh, 2003). Behavioral strategies or actions plans are the most proximal determinants of behavior initiation in the volition stage. Indeed, a number of studies employing the trans-theoretical model have shown behavioral strategies to be significant predictors of behavior onset (For a review see Marshall & Biddle, 2001). In addition to impacting behavior indirectly through behavioral strategies, self-efficacy is posited to directly influence behavioral initiation in the volition stage of the HAPA. Although there is ample evidence of the relationship between self-efficacy and physical activity behavior (e.g., McAuley & Courneya, 1993), it is not clear how much of the influence is accounted for by behavioral strategies.

The HAPA incorporates the concept of behavioral maintenance into the volition stage. As with behavior onset, self-efficacy is posited to determine behavior maintenance (Schwarzer, 1992). However, there is little discussion of how behavior maintenance is determined differentially from behavior onset.

In summary, stage-based models of health behavior change provide more dynamic explanations for physical activity over time. However, existing stage-based models continue to exhibit key weaknesses. The trans-theoretical model has been widely accepted despite its vague depiction of the differential determinants within each proposed stage, and the lack of evidence to support the vague guidelines that are provided (i.e., distinction between behavioral and cognitive processes of change; Marshall & Biddle, 2001). While the HAPA has taken great strides toward delineating specific and differential processes that explain intention formation and behavioral initiation, it does not clearly delineate how the mechanisms of behavioral onset differ from those that determine behavioral maintenance. In addition, no model of physical activity behavior that explicitly incorporates the impact of a physical activity intervention was found. The purpose of the present study was to test an integrated, social-cognitive, stage-based model of physical activity behavior that explains intention formation and physical activity adoption and maintenance in the context of a physical activity intervention.

An Integrated Model

Baranowski, Anderson, and Carmack (1998) have called for the integration of constructs from alternative models. The model for this study proposes that physical activity change occurs through a series of evolving processes that may be set into motion by a theoretically based intervention. Therefore, it is expected that the social cognitive variables will mediate the impact of the intervention on physical activity intention, onset, and maintenance (Figure 1). Because the integrated model is borrowed largely from the HAPA, the names of the first two phases correspond to the stage names in the HAPA. The third phase will be referred to as the *maintenance phase*.

Motivation Phase. Consistent with the HAPA, in the motivation phase, initial outcome expectancies and self-efficacy determine physical activity intentions prior to the start of the intervention. Scwarzer and Fuchs (1996) comment that "If self-efficacy is specified as a mediator between outcome expectancies and intention, the direct influence of outcome expectancy on intention may dissipate" (p. 175). However, it seems likely that for physical activity some expected outcomes exert more direct influence on behavioral intentions than self-efficacy. For example, expectation of muscle soreness may have more of a direct impact on intention or willingness to be physically active, whereas expected time constraints or fears about neighborhood safety may be more likely to influence intention through impacting perceived ability to be physically active. Indeed, in prior research it has been shown that outcome expectancy accounts for variance in physical activity intentions beyond that accounted for by self-efficacy (Resnick, 2001; Rodgers & Gauvin, 1998). Therefore, in the present study it was hypothesized that baseline outcome expectancies would influence behavioral intentions both directly, and indirectly through influencing self-efficacy (Figure 2).

Volition Phase. The Volition phase is initiated with the introduction of the social cognitive intervention. The intervention targets increases in self-efficacy by providing participants with modeling, mastery experiences, achievable short-term goal setting, and presentation of realistic behavioral strategies to achieve those goals. Increased self-efficacy leads participants to actually adopt the behavioral strategies, which in turn leads to an increase in physical activity (Bandura, 1997; Schwarzer, 1992). As posited in the HAPA, it is hypothesized that self-efficacy also influences behavior directly. Therefore, it is hypothesized that in the volition phase, the intervention will directly influence physical activity onset, and this process will be mediated by self-efficacy and behavioral strategies. Specifically, increases in self-efficacy will impact physical activity both directly and through increasing use of behavioral strategies (Figure 2).

Maintenance Phase. The HAPA posits that individuals who have established regular patterns of physical activity maintain their behavior through maintaining a high level of self-efficacy (Schwarzer, 1999). However, Rothman (2000) has argued that the decision to maintain a behavior is determined by each individual's *perceived satisfaction* with the outcomes of the newly adopted behavior. Initial expectations provide a standard against which perceived outcomes are evaluated (Rothman, 2000). If outcomes meet or exceed expectations, then self-efficacy and physical activity will be maintained. If outcomes do not meet expectations, then self-efficacy will decrease, because the behavior will no longer seem worthwhile, and the sedentary behavioral pattern will reappear. Indeed, Sears and Stanton (2001) found that those whose initial positive outcome expectancies were met or exceeded by actual outcomes were less likely to drop out of a physical activity program than those who were disappointed by physical activity outcomes. Similarly, in a descriptive study of 41 women attempting weight-loss, transition from weight loss to weight regain occurred when women no longer experienced positive outcomes of their initial weight loss (Jeffrey, Kelly, Rothman, Sherwood, & Boutelle, 2004). Consistent with the HAPA, the influence of perceived satisfaction on behavioral maintenance may be mediated by self-efficacy, in that those who are satisfied with intervention outcomes are able to maintain their self-efficacy after intervention support-staff and materials are no longer available.

The transtheoretical model posits that the maintenance stage begins when the behavior has been consistent for six months. However, this delineation is arbitrary. In explaining differing processes through the course of an intervention, a plausible transition point from volition phase to maintenance phase is when the intervention is terminated. At this point many of the incentives offered by researchers dry up, and participants are left to consider whether the behavior itself garners enough incentive value to be worth maintaining. Therefore, it is hypothesized that in the maintenance phase, perceived satisfaction with outcomes of the intervention will determine how well they are able to maintain their self-efficacy and physical activity once the intervention has ended.

Methods

Participants and Design

Twenty-three churches in southwestern Virginia were targeted for participation in the study and 14 churches were successfully recruited through telephone contact and meetings with church officials. Healthy church members over the age of 15 were recruited. Head counts were taken during three consecutive weeks of church services to determine an estimate of active church members over the age of 15 at each church. Out of a possible 1811 active church members, a total of 960 participants were successfully recruited into the study at baseline, representing a recruitment rate ranging from 33-65% of active church members, with an overall recruitment rate of 53%. Among the 960 initially enrolled, 930 provided baseline physical activity data.

Because the present study was concerned with social cognitive mediators of change from physical activity intention, to adoption, to maintenance, the study focused on more sedentary participants, who were less likely to already be participating in physical activity. In the present study, pedometers were used as the primary measure of physical activity. Pedometers are small devices (about the size of an electronic pager) that can be clipped to a belt or clothing at the waist, just above one knee. The pedometer records number of steps taken, and has been shown to correlate highly with accelerometer outputs ($r = .86$) and time observed in physical activity ($r = .82$; Tudor-Locke, Williams, Reis, & Pluto, 2002). Mean number of steps per day over a one-week period was recorded at baseline and a median split was used to select the more sedentary half of the sample. This resulted in a subsample of participants who were taking less than 6636 steps at baseline. Tudor-Locke and Bassett (2004) have recently designated less than 5000 steps per day sedentary and 5000-7500 steps “low-active,” thus participants in the present subsample were either sedentary or in the low end of the low-active range.

The subsample consisted of a total of 465 participants providing step-count data at baseline. These participants had a mean age of 58.7, were 69.4% female, 70.6% Caucasian, 26.7% African-American, .4% Asian, and 34.7% reported a household income below $40,000.

Of the baseline participants, 276 provided step-count data at post-assessment, and 314 provided step-count data at follow-up (Figure 2 outlines the participants and attrition rates).

The study employed a nested design, with randomization occurring at the level of the church. Fourteen churches were randomized into one of three conditions: (1) Internet-based intervention (Internet only; *n* = 5); (2) Internet-based intervention with additional supports (Internet plus; *n* = 5); and (3) control (Control; *n* = 4). Randomization was stratified according to ethnicity (there were 3 African-American churches in the sample), denomination, and size. Each participating church was given 3 computers with Internet access. In addition, participants were paid for participating in assessments, $20 at baseline, $30 at post-test, and $40 at follow-up. Churches received $1000 at each assessment point and each church was offered an additional $500 incentive if 95% of its members still enrolled at follow-up completed all pieces of the follow-up assessment. This additional incentive was added to encourage participants to complete all paper and pencil measures (including the step-count log) in response to considerable “paperwork fatigue” reported by participants during post-test. The higher participant payments, the promise that the follow-up assessment was the “last-one” and the group incentive of $500 toward a church project contributed to the increased rate of data collection at the follow-up period.

Intervention

The Guide to Health (GTH) intervention was an Internet-based instructional program targeting change of physical activity and nutrition behavior. The GTH focused on nutrition targets decreasing dietary fat and sugar and increasing dietary fiber and fruits and vegetables with emphasis on portion sizes, meal planning, fast foods, and overall energy balance. The GTH included individualized goal setting, planning, self-monitoring and feedback based on individual's baseline physical activity and nutrition behaviors. Planning components including a physical activity planner for increasing step-counts and a fast-food meal planner that helped participants choose lower calorie and lower fat meals in popular fast food restaurants. The GTH presented text, photos and graphics accompanied by audio narration. There are 12 weekly modules, 4 of which focused on maintenance. Maintenance modules primarily involved continued reporting with feedback on nutrition and physical activity goals. Participants accessed modules on a weekly basis. The computer modules were designed to elicit behavior change through targeting change in cognitive and behavioral constructs theorized by social cognitive theory to mediate behavior change, such as increasing participants' self-efficacy and positive outcome expectancies for the target behaviors, and decreasing perceived barriers and negative outcome expectancies.

The present project focused on physical activity outcomes of the GTH among inactive and low-active participants enrolled in the parent project. The GTH physical activity component revolved around a step-count program using a pedometer provided to every participant. After a baseline period during which mean daily step-counts were collected for each participant, GTH users were asked to commit to a series of weekly goals. These weekly goals generally allowed participants to increase their baseline step counts by 3000 steps per day for 5 days per week by the end of the 12 weekly programs. The 3000 steps per day equates to about 1.5 miles or 30 minutes of walking or related physical activity meeting the Surgeon General's guidelines (Pate et al., 1995); 5 days per week corresponds to "most days of the week" and provides flexibility within the program – with incremental increases of 500 daily steps per week, participants could realistically be expected to reach the goal of 15,000 more steps per week (i.e., 3000 steps X 5 days per week or approximately 2140 steps per day over 7 days) within the course of the program.

Participants could log on to the computer modules at one of the computers provided at their church, from home, work, or wherever a computer with Internet access was available. Participants were encouraged to use the internet program through a number of mechanisms. Project staff were available during Sunday services at each church and one additional night per week to provide assistance with the computer modules and answer any questions that participants had. Posters were hung in each church every Sunday for the first 6-8 weeks and then every other week with church specific information about how many GTH participants were at which module. Automated e-mail reminders were sent once participants initially logged on to the GTH program. At weeks 3-4 and 6-7 research staff called to encourage participants who were lagging behind.

In addition to these mechanisms used to encourage all treatment participants to use the program, churches randomized to the Internet plus condition received a number of additional support mechanisms designed to target physical activity and nutrition behavior, including church announcements, newsletter inserts, letters to participants, a church-wide step-goal program, group feedback on weekly nutrition targets, and mailers reviewing missed content, if a participant got behind in viewing. In Internet plus churches, the prompting to log-on continued during the period between the post-test and follow-up assessment points, as did the additional supports just described.

Measures

Physical activity. Step-counts were measured by Accusplit AE120 pedometers. Accusplit AE120 pedometers provide accurate and reliable measures of step counts (Bassett et al., 1996).

Participants wore pedometers for one week at baseline (prior to filling out social cognitive measures), at post-assessment (5-7 months after baseline), and at follow-up (10-12 months after baseline). During each assessment period, participants wore their pedometers without resetting them and recorded their cumulative steps each day on a step-count log. Participants then returned their step count log and their *un-reset* pedometer to the research staff at the church (see below) or through the mail. In this way, researchers read the un-reset pedometers and recorded the step-count on the participant's step log in order to verify the participant's weekly total step count. At baseline, staff read 86% of participants' pedometers, at post-test 82%, and at follow-up, when participants were told they would be allowed to keep their pedometer after the assessment, causing some confusion about the verification procedure, 70% were verified by staff. Correlations between the total steps recorded by participants complying with the procedure and the total steps recorded by staff from pedometers were high at all three assessment points ($r > .80$). For pedometers returned by mail, rather than carried to the church, the final step count on the log was within 100 to 200 steps (for an entire week) of the step count recorded on the pedometer.

Social Cognitive Measures. Although social cognitive measures relevant to physical activity behavior already existed (e.g., Marcus, Selbi, Niura, & Rossi, 1992), new measures were constructed that were specific to increasing step-counts (See Appendix). Each measure was designed to reflect a specific social cognitive construct and was subjected to primary axis factoring to determine their factor structure. Items that loaded less than .4 on all factors were eliminated (Pedhazur & Pedhazur-Schmelkin, 1991).

Self-efficacy. Self-efficacy (SE) was measured by two scales: $SE_{Behavior,}$ which reflected self-efficacy for carrying out the behaviors necessary to increase step-counts (e.g., "How certain are you that you can park further away to take more steps”), and $SE_{Barrier}$, which reflected self-efficacy for overcoming barriers to increasing step-counts (e.g., “How certain are you that you can increase your daily step count when you are tired”). Each item was rated on a scale of 0 to 100. Item scores loaded on two factors, consistent with the original scales. Three items did not load on either factor and were eliminated. Item scores were averaged for each scale to yield $SE_{Behavior}$ (13 items, $\alpha = .90$) and $SE_{Barrier}$ (8 items, $\alpha = .91$) scale scores with a possible range of 0 to 100.

Outcome expectancy. Outcome expectancy was measured with two scales reflecting positive outcome expectancies (e.g., “If I slowly and steadily build my step count I will be happier") and negative outcome expectancies (e.g., “If I slowly and steadily build my step count I will experience body pain"). For each item participants were asked to indicate the likelihood (expectation) of the outcome and the importance (value) of the outcome on a scale of 1 to 5. Positive outcome expectancy items loaded on one factor with the exception of 2 items (1 likelihood item and 1 value item corresponding to the same outcome statement), which were eliminated. Negative outcome expectancy items loaded on two factors. The majority of items loaded on a single factor, while 8 items (4 likelihood items and 4 corresponding value items) loaded on a separate factor. The items loading on the second factor lacked conceptual similarity and were therefore eliminated. Remaining item scores were averaged to yield positive likelihood (10 items; $\alpha = .92$), positive importance (10 items; $\alpha = .91$), negative likelihood (8 items; $\alpha = .79$), and negative importance (8 items; $\alpha = .79$) subscores. Outcome expectation and outcome value subscores were then multiplied for each participant (Gagne & Godin, 2000; Rotter, 1954) yielding positive outcome expectancy and negative outcome expectancy scores with a possible range of 1 to 25.

Behavioral strategies. The behavioral strategies scale asked participants to rate on a scale of 1 to 5 the extent to which they use strategies targeted by the intervention to increase physical activity (e.g., "Get together with someone else to increase your step-count or physical activity"). With the exception of three items, responses loaded on a single factor. Item scores were averaged to yield a behavioral strategies score, with a possible range of 1 to 5 (7 items; $\alpha = .81$).

Behavioral Intentions. This scale asked participants to rate on a scale of 1 to 5 their intentions to increase their step-counts and to carry out each of the behavioral strategies used to increase step-counts. Ten of the 13 items loaded on a single factor; item scores were averaged to yield a behavioral intentions score, with a possible range of 1 to 5 (10 items; $\alpha = .86$).

Perceived satisfaction (PS). These items asked participants to rate on a scale of 1 to 5 their perceived satisfaction with a number of potential outcomes of increasing step-counts (e.g., "It will change the way I feel about my body"). The majority of items loaded on a single factor, while four items loaded on a second factor that reflected participants' satisfaction with the amount of time needed to increase step-counts. Thus, two perceived satisfaction scales were formed based on a mean of item scores: $PS_{General}$ (11 items, $\alpha = .93$) and PS_{Time} (4 items, $\alpha = .83$).

Procedures

Participants were enrolled at their churches before and after Sunday church services over the course of three months in the fall of 2002. At this time the program was described in flyers, brochures and during pulpit announcements. Congregants were directed to "sign-up" tables where staff answered questions, reviewed informed consent forms with interested members (and parents of members age 15-17), and obtained signatures and contact information for congregants wishing to enroll in the study. Enrollees then signed-up for one of several assessment clinics scheduled at the church the following Saturday or Sunday. Each enrollee was also given demographic, medical history, and health belief questionnaires to complete at home and to hand-in when they returned to the church for their assessment clinic. Finally, participants received verbal and written instructions in the use of the Accusplit pedometers to track daily step *counts without resetting the pedometer for 7 days* using a standard log-format (see above). Participants then returned their step count log and their *un-reset* pedometer to the research staff at the assessment clinic.

Participants in the treatment conditions were able to begin the GTH program once they completed baseline assessments, including step-counts and completion of social cognitive measures. GTH modules were completed over the course of 3-6 months depending on how quickly participants moved through the modules. Post-assessments were conducted once participants completed the GTH modules, but no later than 7 months after completion of baseline assessments, regardless of how far participants had progressed through the program at that point. The additional supports delivered to Internet plus churches continued throughout the follow-up phase; however churches in the Internet only condition received no additional contact during the follow-up period. Control churches received the Internet intervention after completion of follow-up assessment in all intervention churches.

Data Analyses

Methods that account for group-randomization and the interdependence of data from members within these groups are appropriate for examining the effects of community-level prevention trials (Murray, 1998). The church was the unit of analysis upon which analyses of response data were based. Mixed model analysis of variance via the SAS PROC-Mixed procedure (Statistical Analytical System, Version 8.02) was used to test the effects of the intervention on step count and on each of the social cognitive variables. The mixed-model ANOVA equation is as follows:

$$Y_{i:k:l} = \mu + C_l + \mathbf{G}_{K:l} + \varepsilon_{I:k:l}$$

The $Y_{i:k:l}$ response for the i^{th} member of the k^{th} group nested within the l^{th} condition is expressed as a function of the grand mean (μ), the effect of the lth condition (C_l) and the realized value of the k^{th} group ($\mathbf{G}_{K:l}$; which is included as a categorical, random effect). The effect of primary interest in evaluating the effectiveness of the intervention is that attributed to group ($\mathbf{G}_{K:l}$) indicating that the Internet and Internet plus churches increased step-counts more than the Control group at post- and follow-up assessments. The SAS (Statistical Analytical System, Version 8.02) mixed-model macro GLIMMIX was used to test the effects of the intervention on meeting the goal of increasing step-counts by 2140 per week. This model, which uses iteratively reweighted likelihoods, fits the specified model by the method of restricted maximum likelihood estimation (REML) for parameter estimation. The SAS macro GLIMMIX enables the use of non-Gaussian residual error distributions in model specification.

Structural equation modeling (LISREL 8.54; Joreskog and Sorbom, 2003) was used to test each of the 3 hypotheses corresponding to the 3 proposed phases: motivation, volition, and maintenance. Structural equation modeling has been recommended as an effective method for conducting mediator analysis (Baron & Kenny, 1986). Latent variable models corresponded to the 3 conceptual models depicted in Figure 1. Each latent variable was indicated by one or two measured constructs, based on the results of prior exploratory factor analysis. For example, the latent variable self-efficacy was defined as the construct underlying $SE_{Behavior}$ and $SE_{Barrier}$.

Perceived satisfaction was defined as the construct underlying $PS_{General}$ and PS_{Time}. Due to the low correlation between positive outcome expectancy and negative outcome expectancy measures, a latent variable represented by a single indicator was created for each of these constructs. All other constructs were represented by single indicators. When multiple indicators are used, structural equation modeling controls for the unreliability within the indicators. For latent variables with single indicators, error terms for the measured variables were specified as one minus the measure's reliability multiplied by the variance. For multi-item scales the measures of internal consistency were used as a measure of reliability, while the average correlation between pedometers and accelerometers (i.e., $r = .86$; Tudor-Locke, Williams, Reis, & Pluto, 2002) was used as an indicator of reliability for step-counts. The error variance for treatment condition was set equal to zero as this variable was manipulated and included no error.

For valid interpretation of structural equation modeling, model specification must be justified and data must conform to tests of multivariate normality (McDonald & Ringo Ho, 2002). Model specificity refers to the basis for hypothesized relationships within the model. In the present study, specificity of each structural model is based on the theoretical underpinnings of the models outlined in the introductory section. Non-normality of the data may unduly influence results. All variables from the motivation phase showed significant skewness (Table 1). Attempts made to normalize the data were unsuccessful. Therefore, data were categorized into quartiles in order to normalize the data. In the volition phase, change in step-counts from baseline to post-assessment was non-normal (*skewness statistic* = 1.27, *SE* = .15; *kurtosis statistic* = 4.11, *SE* = .29). In order to normalize the data, scores were standardized and outliers were eliminated ($z > 2.4$; $n = 6$). These modifications resulted in a normal distribution for this variable (*skewness statistic* = .27, *SE* = .15; *kurtosis statistic* = .14, *SE* = .30). In the maintenance phase, non-normal data was found for change in step-counts from baseline to follow-up (*skewness statistic* = 1.12, *SE* = .14; *kurtosis statistic* = 3.61, *SE* = .27). In order to normalize the data, scores were standardized and outliers were eliminated ($z > 3$; *n* = 6). These modifications resulted in a normal distribution for this variable (*skewness statistic* = .24, *SE* = .14; *kurtosis statistic* = .03, *SE* = .28). In addition to eliminating outlier values of change in step-count in the maintenance model, outliers (*n*= 3) for the variables change in $SE_{Behavior}$ and change in $SE_{Barrier}$ had to be eliminated to achieve normality in those variables (*skewness statistic* = -.18, *SE* = .14 and *skewness statistic* = -.17, *SE* = .15, respectively). Note, in all attempts to normalize variable distributions, individual scores, not subjects, were eliminated from the data-set. In order to make full use of available data, full information maximum likelihood modeling was used. Fit of the model to the data was evaluated by root-mean-square error of approximation (RMSEA) and chi-square. Fit was judged to be good when RMSEA was not significantly higher than .05 and when Chi-Square indicated the difference between the model expected from the specified relations did not differ significantly from the model observed in the data. Standardized effects were judged to be strong if they exceeded .40, moderate if between .20 and .39, and small, but meaningful if less than .20 and significant (Pedhazur, 1982). Mediation can be inferred *to have occurred* when three conditions are met: (1) treatment (or outcome expectancy in the motivation model, self-efficacy in the volition model, or perceived satisfaction in the maintenance model) has a significant total effect on behavior (or intentions in the motivation model), (2) treatment (or outcome expectancy, self-efficacy, or perceived satisfaction) has a significant effect on mediator variables, and (3) the mediator variables exert significant total effects on behavior (or intentions in the motivation model). Complete mediation of a variables' effect can be inferred when a fourth condition is met: the direct effects of treatment (or outcome expectancy, self-efficacy, or perceived satisfaction) on behavior (or intentions) is zero (Baron & Kenny, 1986).

Results

Preliminary Analyses. Means and standard deviations for measured variables used in each model are shown in Table 2. There were no significant differences at baseline across the three conditions for demographic variables, step-counts, or any of the social cognitive variables (alpha < .05). However, participants in the Internet plus condition completed more computer modules on average than participants in the Internet only condition (*Estimated Mean* = 8.31, *se* = .54 and *Estimated Mean* = 6.33, *se* = .57, respectively; $t_{(9)} = 2.50$, $p < .03$). Further analyses indicated that a higher percentage of participants in the Internet plus condition than participants in the Internet only condition completed the first four treatment modules (71.4% and 49.7%, respectively; Table 3). Similar, but non-significant trends were observed when comparing completion rates for the orientation module (81.9% and 68.6%), the first 8 treatment modules (59.3% and 43.8%), and all modules, including the maintenance modules (44.5% and 33.3%; Table 3). Those providing step-count data at post-assessment were significantly older than those who did not provide post-assessment step-count data ($M = 58.8$, $SD = 4.2$ and $M = 53.3$, $SD = 16.8$, respectively; $t_{(446)} = 3.63$, $p < .001$). However, no other differences were observed in the demographic, social cognitive, or behavioral characteristics of participants who returned and did not return for the follow-up assessment (alpha < .05).

Motivation Model. Intervariable correlations for the measured variables included in the Motivation model are presented in Table 2. The total and indirect effects of latent variables on behavioral intention formation are presented in Table 4. The completely standardized parameter coefficients associated with factor loadings and direct effects from the structural equation analysis are shown in Figure 3. Within Figure 3, latent variables are enclosed in ellipses and measured variables are enclosed in rectangles; numbers next to the arrows between latent variables indicate direct effects of one variable on the other. Numbers next to the arrows from latent variables to measured variables indicate factor loadings. Goodness of fit indices indicated a good fit of the model to the data: RMSEA = .00, p = .83; $\chi^2_{(1, N = 465)} = .13$, p = .72. Twenty-eight percent of the variance in behavioral intention formation was explained by the model. Within the motivation model, positive outcome expectancy exerted a moderate total effect on behavioral intentions ($ß_{(total)} = .36$; $p < .01$). This total effect was partly direct ($ß_{(direct)} = .20$; $p < .01$) and partly indirect ($ß_{(indirect)} = .16$; $p < .01$) through self efficacy. Negative outcome expectancy did not effect behavioral intentions ($ß_{(total)} = -.10$; $p > .05$). Self-efficacy exerted a strong total effect on behavioral intentions ($ß_{(total)} = .41$; $p < .01$). Finally, positive and negative outcome expectancy variables each influenced self-efficacy ($ß_{(total)} = .40$; $p < .01$; $ß_{(total)} = -.17$; $p < .01$, respectively), and the effect of positive outcome expectancy on behavioral intentions through self-efficacy met all three criteria to conclude self-efficacy partially mediated the effect of positive outcome expectancy on behavioral intentions.

Volition Model. Prior to SEM analysis, mixed model analysis of variance revealed a significant effect of the intervention on each of the measured variables in the Volition Model (Table 5). Post-hoc comparisons revealed significant differences between the Internet plus condition and the control condition for all variables in the model and significant differences between the Internet only condition and Internet plus condition for $SE_{Behavior}$, $SE_{Barrier}$, and behavioral strategies. Mixed-model GLIMMIX analysis revealed no differences among treatment groups in meeting the goal of increasing step-counts by 2140 at post-assessment (Internet plus = 56.2%, Internet only = 36.8%, Control = 28.6%; $F_{(2,10)} = 2.22$, p = .16). Intervariable correlations for the measured variables included in the Volition model are presented in Table 2. The total and indirect effects of latent variables on physical activity onset are presented in Table 6. The completely standardized parameter coefficients associated with factor loadings and direct effects from the structural equation analysis are shown in Figure 4. Goodness of fit indices indicated a good fit of the model to the data: RMSEA = .00, p = .76; $\chi^2_{(2, N = 298)} = 1.11$, p = .58. Nineteen percent of the variance in physical activity adoption was explained by the model. Within the volition model, the intervention exerted a moderate total effect on physical activity onset ($ß_{(total)}$ = .29; p < .01). This total effect was partly direct ($ß_{(direct)}$ = .20; p < .01) and partly indirect ($ß_{(indirect)}$ = .09; p < .01) through change in self-efficacy and adoption of behavioral strategies. Although change in self-efficacy did not have a significant total effect ($ß_{(total)}$ = .10; p > .05) or direct effect ($ß_{(direct)}$ = -.02; p > .05) on physical activity onset it did have a weak indirect effect ($ß_{(indirect)}$ = .12; p < .01). This discrepancy can be explained by the fact that self-efficacy's direct effect on physical activity, though non-significant, was slightly negative, thus detracting from the otherwise positive total effect. Adoption of behavioral strategies exerted a moderate total effect on physical activity onset ($ß_{(total)}$ = .31; p < .01). Change in self-efficacy had a moderate effect on adoption of behavioral strategies ($ß_{(total)}$ = .38; p < .01); however, because the total effect of self-efficacy on physical activity onset was non-significant, adoption of behavioral strategies can *not* be said to mediate the effect of change in self-efficacy on physical activity onset. Finally, the intervention had moderate effects on both adoption of behavioral strategies ($ß_{(total)}$ = .20; p < .01) and change in self-efficacy ($ß_{(total)}$ = .29; p < .01), and the effect of the intervention on physical activity onset through adoption of behavioral strategies met all three criteria to conclude adoption of behavioral strategies partially mediated the effect of the intervention on physical activity onset.

Maintenance Model. Mixed model analysis of variance revealed a significant effect of the intervention on $SE_{Barrier}$ and step-counts, but not on $PS_{General}$, PS_{Time}, or $SE_{Behavior}$, (Table 4). Post-hoc comparisons revealed significant differences between the Internet plus condition and the control condition for $SE_{Barrier}$ and step-counts. Mixed-model GLIMMIX analysis revealed no differences among treatment groups in meeting the goal of increasing step-counts by 2140 at follow-up (Internet plus = 40.6%, Internet only = 32.2%, Control = 26.6%; $F_{(2,10)} = 2.45$, p = .14). Intervariable correlations for the measured variables included in the Volition model are presented in Table 2. The total and indirect effects of latent variables on physical activity onset are presented in Table 7. The completely standardized parameter coefficients associated with factor loadings and direct effects from the structural equation analysis are shown in Figure 5. Goodness of fit indices indicated a good fit of the model to the data: RMSEA = .02, p = .68; $\chi^2_{(5, N = 288)} = 5.89$, p = .32. Nine percent of the variance in physical activity maintenance was explained by the model. Within the maintenance model, the intervention exerted a moderate total effect on physical activity maintenance ($ß_{(total)} = .20$; p < .01). This total effect was partly direct ($ß_{(direct)} = .16$; p < .05) and partly indirect ($ß_{(indirect)} = .04$; p < .05) through perceived satisfaction and maintained self-efficacy. The intervention did not have an effect on perceived satisfaction ($ß_{(total)} = .13$; p > .05) nor did perceived satisfaction have an effect on maintained self-efficacy ($ß_{(total)} = .13$; p > .05) or physical activity maintenance ($ß_{(total)} = .05$; p > .05). The intervention had a weak effect on maintained self-efficacy ($ß_{(total)} = .16$; p < .05). The effect of the intervention on physical activity maintenance through maintained self-efficacy met all three criteria to conclude maintained self-efficacy partially mediated the effect of the intervention on physical activity maintenance.

Discussion

The primary purpose of this paper was to test an integrated model of physical activity intention formation, onset, and maintenance in the context of a social cognitive intervention. Three separate models corresponding to each phase of the overall model were tested via structural equation modeling. Each model provided a good fit to the data, thus generally supporting the overall model. Some specific hypotheses concerning the interrelationships among variables within each model were supported, while others were not.

In the motivation model, both positive outcome expectancy and self-efficacy had significant total effects on behavioral intention. As hypothesized self-efficacy partially mediated the impact of positive outcome expectancy on behavioral intention. This finding is consistent with the HAPA, which posits that outcome expectancy precedes self-efficacy during intention formation (Schwarzer, 1992). In addition, these findings are consistent with Kirsch's argument that outcome expectancy effects self-efficacy for behaviors that are under our volitional control (Kirsch, 1982), such as increasing step-counts. Positive outcome expectancy also exerted a direct effect on behavioral intention, suggesting that outcome expectancy influences behavioral intention in ways other than through self-efficacy. This is consistent with previous studies showing that outcome expectancy accounts for variance in physical activity intentions beyond that accounted for by self-efficacy (Resnick, 2001; Rodgers & Gauvin, 1998). Contrary to hypotheses, negative outcome expectancy did not have a significant effect on self-efficacy or behavioral intention. This finding is somewhat surprising given the moderate to strong associations that have been found between physical activity intentions and perceived barriers (r = -.39 to -.45; Bozionelos & Bennet, 1999; Payne, Jones, & Harris, 2002), a construct conceptually similar to negative outcome expectancies (Williams, Anderson, Winett, in press). One possible explanation for the null findings is the potential lack of familiarity with the negative outcomes of physical activity. While the positive outcomes of physical activity are often discussed in the news-media, the present subsample of sedentary participants may have been less familiar with the negative outcomes of physical activity prior to the intervention, thus damaging the predictive validity of their responses.

As expected, in the volition model, both the intervention and adoption of behavioral strategies had significant total effects on physical activity onset. Also as hypothesized, the effect of the intervention on physical activity onset was partially mediated by adoption of behavioral strategies. This increase in physical activity through adoption of behavioral strategies was consistent with the goals and purpose of the intervention. However, the intervention also had a direct effect on physical activity, indicating that it increased physical activity onset through pathways that were not measured in the current model. Contrary to hypotheses, change in self-efficacy did not have a significant total effect on physical activity. The overall mean change in self-efficacy was negative (Table 2), suggesting that self-efficacy ratings decreased from baseline to post-assessment. Bandura (1997) has cautioned that self-efficacy ratings may *not* be predictive of behavior when participants are not familiar with the target behavior. Given that this subsample of participants was selected for their baseline sedentary behavior, it could be argued that baseline self-efficacy ratings were artificially inflated, due to unfamiliarity with the behavior of increasing step-counts, thus damaging the validity of self-efficacy change scores. On the other hand, consistent with hypotheses, the intervention had a moderate effect on change in self-efficacy, which in turn had a moderate effect on adoption of behavioral strategies. Moreover, maintained self-efficacy, a latent variable also defined by self-efficacy change scores, had a significant, moderate effect on physical activity maintenance in the maintenance model. Taken together, these latter findings support the validity of the self-efficacy change scores, and suggest that the non-significant effect of change in self-efficacy on physical activity onset may instead be due to lack of importance of self-efficacy in determining the onset of physical activity.

In the maintenance model, both the intervention and maintained self-efficacy had significant total effects on physical activity onset. Also as hypothesized, the effect of the intervention on physical activity maintenance was partially mediated by maintained self-efficacy. This increase in physical activity maintenance through maintained self-efficacy was consistent with intervention goals to maintain self-efficacy. The negative mean changes in maintained self-efficacy indicate that greater decreases in self-efficacy led to smaller increases in step-counts from baseline to follow-up. Again, the intervention also had a direct effect on physical activity, indicating that it increased physical activity onset through pathways that were not measured in the current model. Contrary to hypotheses, perceived satisfaction did not have a significant total effect on physical activity. Satisfaction with outcomes of the intervention relative to initial expected outcomes may be especially difficult to achieve because expectancies are often artificially elevated at the start of attempted behavioral change, a phenomenon referred to by Polivy and Herman (2002) as the “false hope syndrome”. Moreover, even if expected outcomes are reached, behavior may be abandoned if it is perceived that too much effort was required to attain the positive outcomes (Jeffrey et al., 2004). Thus, perceived effort may be an important moderator of the relationship between perceived satisfaction and behavior maintenance.

It should be noted that intervention effects in the maintenance model largely reflected differences between the control and Internet plus conditions (see Table 4). Recall that additional support mechanisms (e.g., church announcements, letters to participants) were provided for the Internet plus condition throughout the 12-month assessment period, whereas the Internet only condition received no contact after the first 7 months. This indicates that the additional support mechanisms provided in the Internet plus condition played an important role in maintaining increases in step counts directly and through their influence on maintenance of self-efficacy. Future research should examine which support mechanisms were most influential.

The findings must be viewed in the context of the study's limitations. First, although the study tests determinants of 3 separate processes, it is not a true test of a stage theory, as it does not test movement from intention formation to behavior onset, to behavior maintenance (Weinstein, Rothman, & Sutton, 1998). Second, variables are measured at only 3 time points, thus limiting full examination of changes during the intervention and follow-up periods. Moreover, despite the present study's examination of change in determinants over time (i.e., volition and maintenance models), in most cases determinants and criterion variables are operationalized via change scores over identical time-periods, thus not allowing for temporal ordering of the model's variables (Baronowski, Anderson, & Carmack, 1998). Third, structural analysis provided an appropriate means to test the proposed integrated model, but it was less well suited for the present study's nested design. Ideally, treatment effects in the tested model would be nested within the randomization-groups or churches. Thus, the standard errors that LISREL 8.54 provided may have underestimated the true uncertainty in the model parameters. Finally, structural equation modeling offers a means for supporting or rejecting the theory in question, but it cannot simultaneously reject alternative theories (Pedhazur & Pedhazur-Schmelkin, 1991). For example, in the present model outcome expectancy is modeled to precede self-efficacy in determining behavioral intention, but it is possible that if modeled differently, evidence could be found in support of the reverse relationship.

In summary, the present study tests an integrated social cognitive model that differs from previous stage-based models in its accounting for the social cognitive intervention as a primary determinant that influences physical activity onset and maintenance through its effects on specific theoretical variables. Previous models of health behavior change have failed to account for the effects of the theoretically based intervention and the different processes that mediate those effects prior to, during, and following the intervention, despite the inevitable testing of these models in the context of such interventions. The model tested here also differs from the transtheoretical model in its specification of the processes that determine intention formation and behavior onset maintenance. The present model differs from HAPA in its inclusion of perceived satisfaction with intervention outcomes as a determinant of physical activity maintenance (Rothman, 2000). The findings provide preliminary evidence that intention formation, behavior onset, and behavior maintenance are distinct processes driven by different determinants before, during, and following a social cognitive physical activity intervention. Specifically, the present findings support the proposed model in that: (1) Self-efficacy mediates the effect of positive outcome expectancy on behavioral intention; (2) adoption of behavioral strategies mediates the effect of the intervention on physical activity onset; and (3) maintenance of self-efficacy mediates the effect of the intervention on physical activity maintenance. Contrary to hypotheses change in self-efficacy from baseline to post-assessment and perceived satisfaction with intervention outcomes did not have effects on physical activity onset or maintenance. These findings suggest that self-efficacy may be more important during intention formation and physical activity maintenance than during physical activity onset. It is recommended that future research test the effects of perceived satisfaction in conjunction with perceived effort as a potential moderator (Jeffrey et al., 2004). In addition, it is recommended that future study examine theorized determinants of physical activity onset and maintenance at multiple time points *during* the intervention and follow-up periods.

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Table 1

Skewness of Variables in the Motivation Model [a]

	Prior to Categorization	Following Categorization Into Quartiles
	Skewness (SE)	Skewness (SE)
Positive OE	-.80 (.12)	.09 (.12)
Negative OE	.66 (.12)	.03 (.12)
$SE_{Behavior}$	-.77 (.12)	.00 (.12)
$SE_{Barrier}$	.03 (.12)	.02 (.12)
Behavioral Intentions	-.79 (.14)	.10 (.14)

Note. OE = Outcome Expectancy, SE = Self-Efficacy.

[a] Variables measured at baseline

Table 2

Means, Standard Deviations, and Correlations Among Measured Variables in Each Model

	Possible Range	*M*	*SD*	1	2	3	4
Motivation Model [a]							
1. Positive OE	1 – 25	18.47	6.01	--			
2. Negative OE	1 – 25	7.05	3.90	.00	--		
3. $SE_{Behavior}$	0 – 100	68.44	20.33	.39**	-.18**	--	
4. $SE_{Barrier}$	0 – 100	57.44	22.70	.36**	-.19**	.76**	--
5. BI	1 – 5	3.82	.73	.36**	-.10	.52**	.38**
Volition Model [b]							
1. $SE_{Behavior}$	-100 – 100	-3.44	18.61	--			
2. $SE_{Barrier}$	-100 – 100	-2.11	21.03	.60**	--		
3. Strategies	-5 – 5	.54	.91	.31**	.28**	--	
4. Step-Counts	-4869 – 15995 [d]	1872	2675	.11	.11	.26**	--
Maintenance Model [c]							
1. $PS_{General}$	1 – 5	3.67	.90	--			
2. PS_{Time}	1 – 5	3.55	.84	.68**	--		
3. $SE_{Behavior}$	-100 – 100	-5.67	19.61	.10	.13*	--	
4. $SE_{Barrier}$	-100 – 100	-3.69	21.53	.13*	.14*	.64**	--
5. Step-Counts	-4650 – 16665 [d]	1392	2804	.08	.06	.19**	.17**

Note. OE = Outcome Expectancy, SE = Self-Efficacy, BI = Behavioral Intention, PS = Perceived Satisfaction.

[a] Variables measured at baseline

[b] Variables reflect change from baseline to post-assessment

[c] $PS_{General}$ and PS_{Time} measured at post-assessment; $SE_{Behavior}$, $SE_{Barrier}$, and Step-Counts reflect change from baseline to follow-up.

[d] Actual ranges

* $p < .05$

** $p < .01$

Table 3

Percentage of participants in Internet only and Internet plus conditions completing treatment modules (n = 335)

Completion of:	% of Internet Only Participants	% of Internet Plus Participants	*t*-value
Orientation Module	68.6	81.9	2.04
Module 4	49.7	71.4	2.83*
Module 8	43.8	59.3	1.96
All Modules	33.3	44.5	1.40

* $p < .05$

Table 4

Standardized Indirect and Total Effects of Latent Variables in the Motivation Model on Behavioral Intentions [a]

	Effects on Behavioral Intentions	
	Indirect	Total
Positive OE	.16**	.36**
Negative OE	-.07	-.10
Self-efficacy		.41**

Note. OE = Outcome Expectancies.

[a] Variables measured at baseline

* $p < .05$

** $p < .01$

Table 5

Mixed-Model ANOVA[a] Estimates of Means, Standard Errors and Effect Sizes Among Participants in Internet-Plus, Internet-Only and Control Churches

	Control (A) *m (se)*	Internet Only (B) *m (se)*	Internet Plus *(C)* *m (se)*	*t*-value A vs. B	*t*-value A vs. C	*t*-value B vs. C
Stage 2 [a]						
$SE_{Behavior}$	-8.70 (2.22)	-5.79 (2.12)	2.62 (1.94)	.95	3.83**	2.92*
$SE_{Barrier}$	-5.84 (2.60)	-5.60 (2.49)	3.68 (2.28)	.07	2.75*	2.75*
Strategies	.21 (.10)	.51 (.10)	.83 (.09)	2.14	4.67**	2.43*
Step-counts	1160.5 (406.7)	1679.7 (379.7)	2576.5 (362.3)	.93	2.60*	1.71
Stage 3 [b]						
$PS_{General}$	3.73 (.12)	3.78 (.11)	4.01 (.11)	.35	1.73	1.45
PS_{Time}	3.61 (.10)	3.64 (.09)	3.77 (.09)	.17	1.11	.98
$SE_{Behavior}$	-8.72 (2.10)	-4.37 (2.09)	-4.51 (1.71)	1.47	1.55	-.05
$SE_{Barrier}$	-7.85 (2.32)	-4.53 (2.31)	-.41 (1.87)	1.02	2.50*	1.39
Step-Counts	731.3 (285.7)	1339.6 (297.0)	1892.7 (240.2)	1.48	3.11*	1.45

Note. OE = Outcome Expectancies, SE = Self-efficacy, BI = Behavioral Intentions, PS = Perceived Satisfaction.

[a] Variables reflect change from baseline to post-assessment

[b] $PS_{General}$ and PS_{Time} measured at post-assessment; $SE_{Behavior}$, $SE_{Barrier}$, and Step-Counts reflect change from baseline to follow-up.

* $p < .05$

** $p < .01$

Table 6

Standardized Indirect and Total Effects of Latent Variables in the Volition Model on Physical Activity Onset [a]

	Effects on Physical Activity Onset	
Variable	Indirect Effects	Total Effects
Condition	.09**	.29**
Self-Efficacy	.12**	.10
Strategies		.31**

[a] Variables reflect change from baseline to post-assessment

* $p < .05$

** $p < .01$

Table 7

Standardized Indirect and Total Effects of Latent Variables in the Maintenance Model on Physical Activity Maintenance [a]

	Effects on Physical Activity Maintenance	
Variable	Indirect Effects	Total Effects
Condition	.04*	.20**
Perceived Satisfaction	.03	.08
Self-Efficacy		.21**

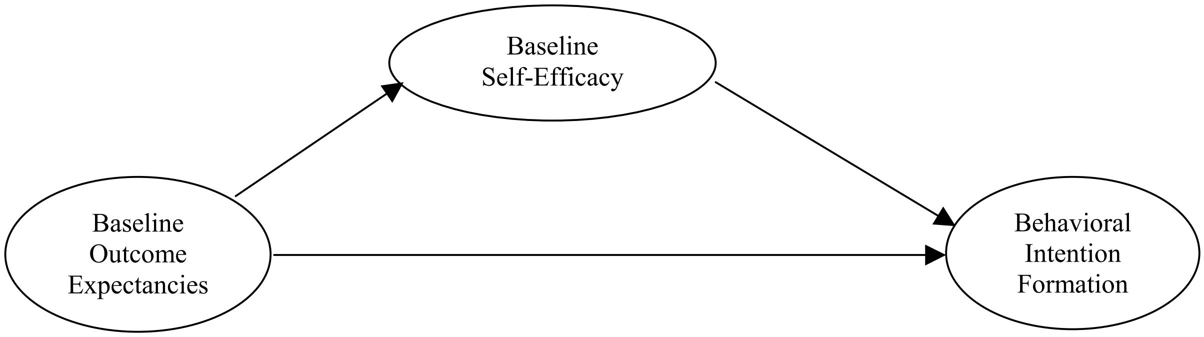
[a] Perceived Satisfaction measured at post-assessment; Self-Efficacy reflects change from baseline to follow-up

* $p < .05$

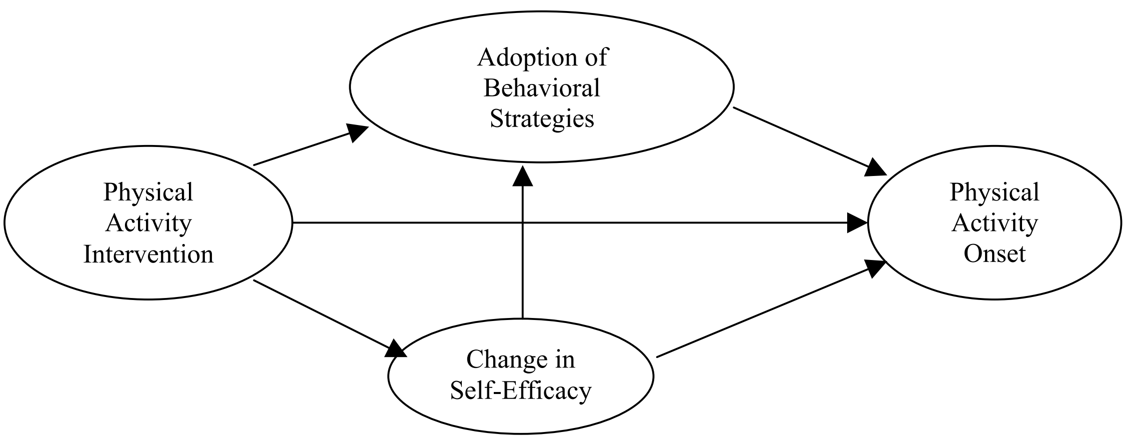
** $p < .01$

Figure 1. Graphical Representation of the Integrated Model.

Motivation Phase.



Volition Phase.



Maintenance Phase.

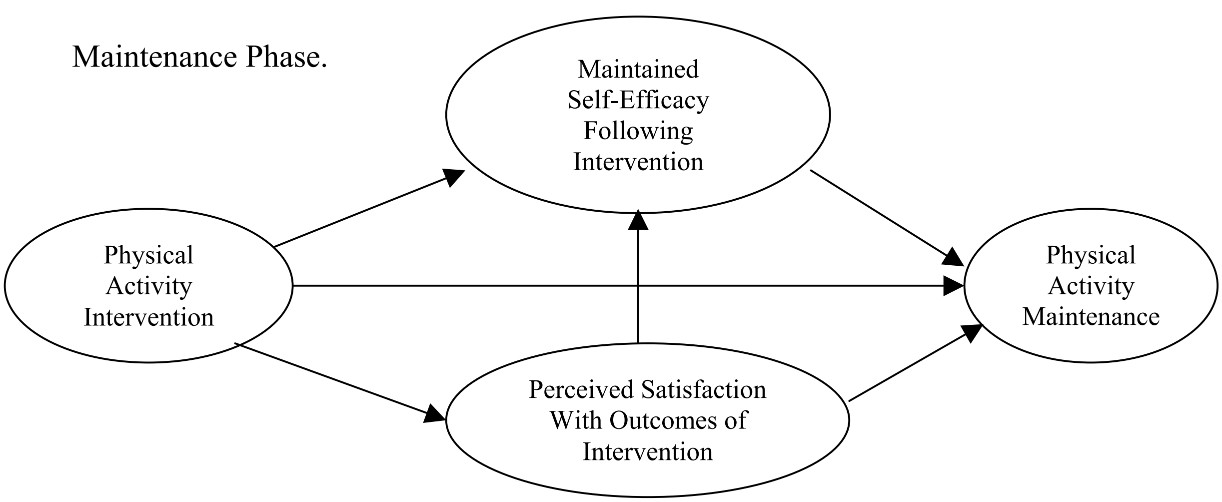


Figure 2. Participant Recruitment, Enrollment, and Attrition.

Number of Participants	% of Previous Sample
Total Active Church Members = 1811	
Enrolled Participants = 960	53%
Participants Providing Baseline Step-Count Data = 930	97%
More Sedentary Participants (Median Split) = 465	50%
Participants Providing Step-Count Data at Post-Assessment = 276	59%
Participants Providing Step-Count Data at Follow-up = 314	68%*

* Percent of more sedentary participants (n = 465)

Figure 3. Motivation Phase

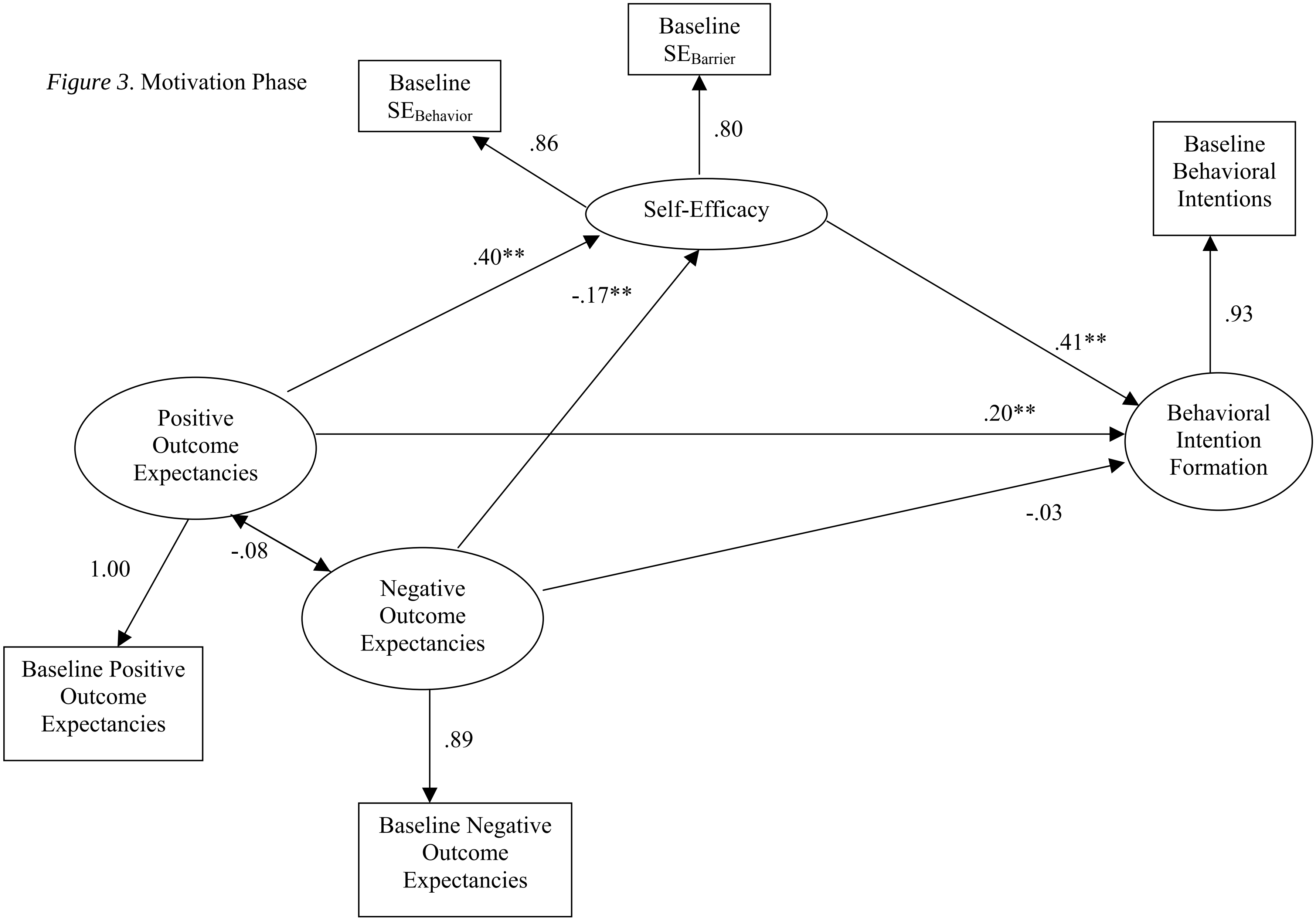


Figure 4. Volition Phase.

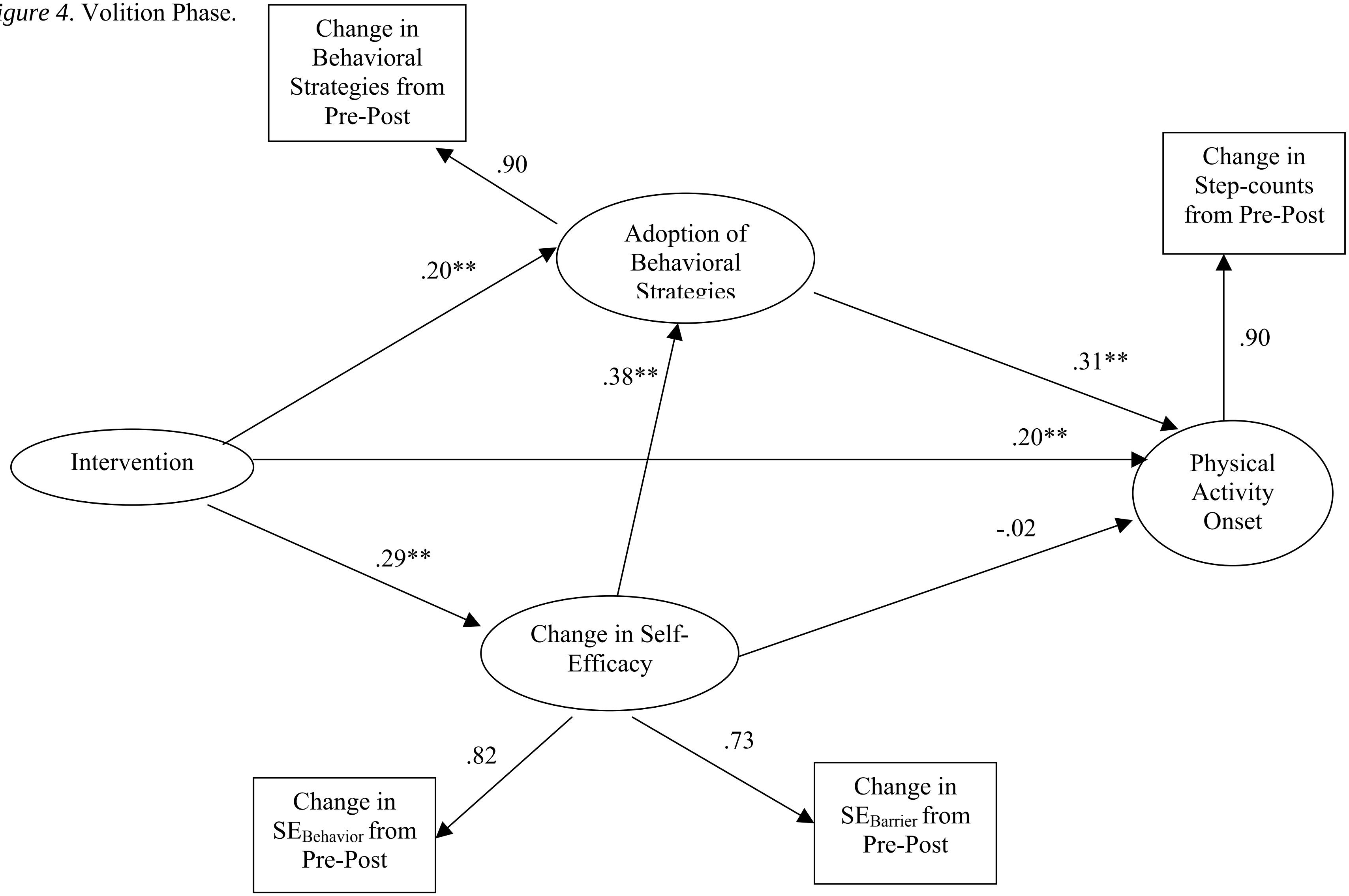
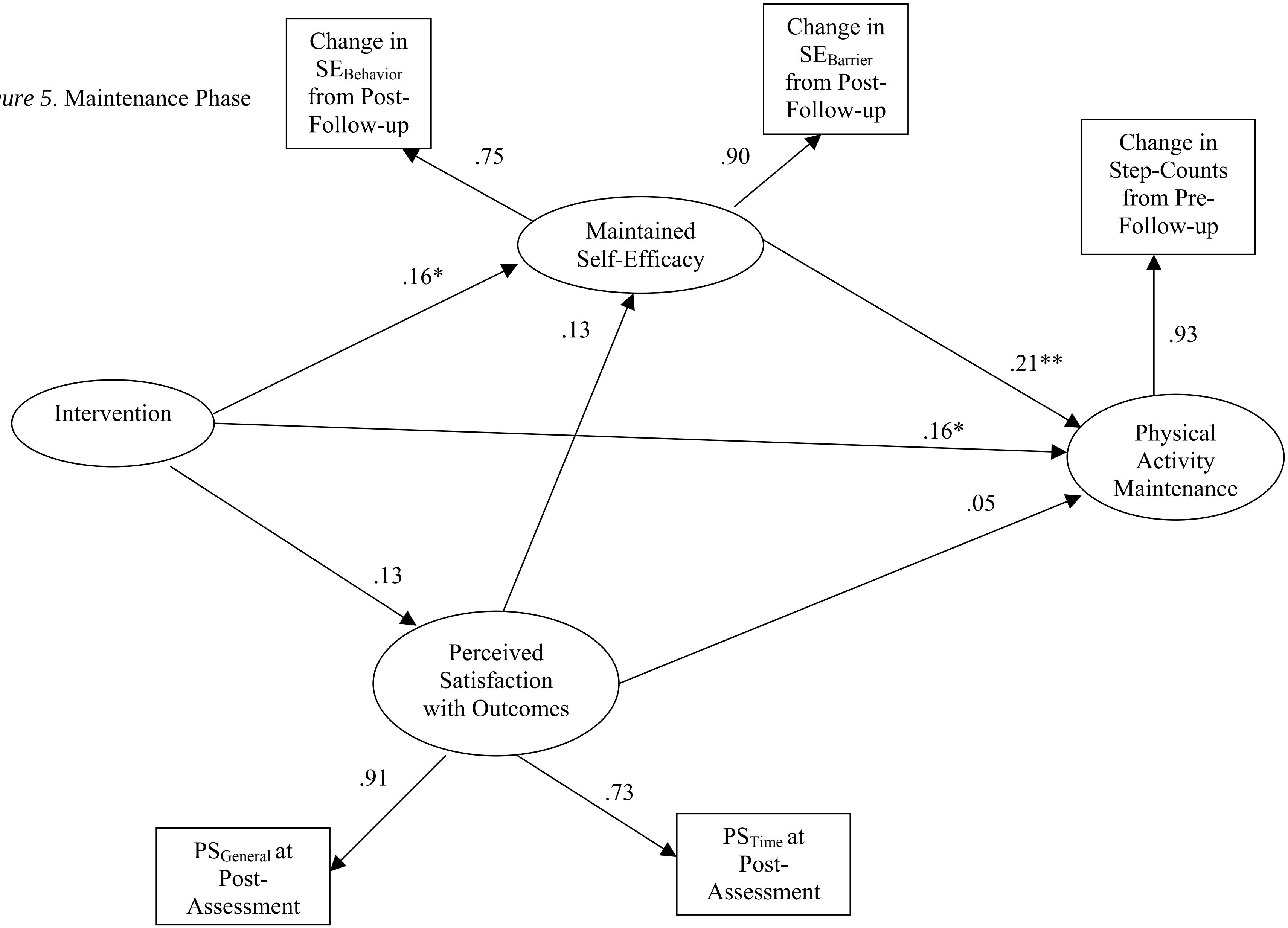


Figure 5. Maintenance Phase



Appendix

Social Cognitive Measures

Step-Count Strategies

These questions ask about what strategies you have used in the past 3 months to increase your daily step-count or physical activity.

Use this scale to tell us how often in the past month you did the following:

1	2	3	4	5
Never	**Seldom**	**Occasionally**	**Often**	**Repeatedly**

In the past month how often did you:	**How Often (1-5)**
1. Set aside time each day to increase your daily step-count or physical activity?	
2. Take the stairs instead of an elevator?	
3. Write down in your calendar each week your plans to increase your daily step-count or physical activity?*	
4. Plan other places to increase your daily step-count or physical activity if the weather is bad?	
5. Keep track of how many steps you are taking?*	
6. Walk instead of drive when going out for lunch or doing errands?	
7. Find or hire a babysitter so you can increase your daily step-count or physical activity?*	
8. Take short breaks to increase your daily step-count or physical activity during the day?	
9. Park farther away from school or work to increase your daily step-count or physical activity?	
10. Get together with someone else to increase your step-count or physical activity?	

* Items were eliminated based on factor analysis

Step-Count Efficacy

These questions ask how CERTAIN you are that you can do different things to increase your physical activity by:

building up your daily step-count.

You will be asked to decide how certain or how sure you are that you can "slowly and steadily build up your daily step-count" on most days and in lots of different situations.

Think about times when it will be easy to build up your step-count and when it will be harder.

When deciding how sure you are, we want you to think about increasing your step-count or physical activity …

EVERY DAY or ALMOST EVERY DAY, not just once or twice.

For a long time…until next year …or even longer!

In a lot of different situations …

- at work or school …
- when the weather is bad …
- when you are feeling stressed or depressed …
- when you can't find someone to increase your daily step-count with you …
- when you are busy.

Step-Count Efficacy

Use any number from 0 to 100 on the following scale to tell how certain you are that you can – all or most of the time:

0 Certain I CAN NOT	----------	50 Somewhat certain I can	-----------	100 Certain I CAN

How certain are you that you can ...	How certain? (0-100)
1. get up early during the week to build up your daily step-count?*	
2. get together with someone else to increase your step-count?[a]	
3. walk as a way to increase your daily step-count?[a]	
4. use the stairs at work or school instead of the elevator?[a]	
5. go to social events or fun activities only after reaching your daily step-count goal?[a]	
6. take small breaks during the day to increase your daily step-count?[a]	
7. begin increasing your step-count again if you miss a day or two?[a]	
8. park farther away to take more steps?[a]	
9. each week, increase your daily step-count by 500 steps?[a]	
10. find a place to increase your daily step-count during bad weather?[a]	
11. increase your daily step-count by 500 steps, each week for 8 weeks?[a]	
12. keep track of how many steps you are taking?[a]	
13. change your normal routine to increase your daily step count?[a]	

Step-Count Efficacy

Use any number from 0 to 100 on the following scale to tell how certain you are that you can – all or most of the time:

0 Certain I CAN NOT	----------	50 Somewhat certain I can	----------	100 Certain I CAN

How certain are you that you can ...	How certain? (0-100)
14. stay up later to make time for building up your daily step-count?*	
15. make a plan to increase your daily step-count?[a]	
How certain are you that you can increase your daily step-count when ...	
16. you are feeling stressed?[b]	
17. you are tired?[b]	
18. your family wants more time?[b]	
19. your muscles might be a little sore?[b]	
20. you get busy at work?[b]	
21. you have social activities?[b]	
22. you have chores or errands to do?[b]	
23. you need a babysitter to do so?*	
24. you are feeling depressed?[b]	

* Items were eliminated based on factor analysis

[a] Items loading on $SE_{Behavior}$

[b] Items loading on $SE_{Barrier}$

Physical Activity Outcomes

These questions ask about what you expect will happen *if you were to slowly and steadily increase your daily step count or physical activity*. They also ask about how much it would matter to you for these things to happen.

Use this scale to tell us if you agree the following will happen:

1	2	3	4	5
Strongly Disagree				Strongly Agree

Use this scale to tell us how much it will matter:

1	2	3	4	5
It will not matter at all				It will matter very much

If I slowly and steadily build up my daily step count I will …	Do you agree? (1-5)	Will it matter? (1-5)
25. have to change my normal routine.[b]		
26. be doing what is right for me.[a]		
27. wear out my shoes too fast.*		
28. be happier.[a]		
29. be less irritable.[a]		
30. have to give up some of my normal activities.[b]		
31. have to take more time than usual to plan my day.[b]		
32. experience body pain.[b]		
33. have one more thing to worry about getting done.[b]		
34. have to buy special walking shoes.*		
35. not have enough time for other things I want to do.[b]		
36. feel better about my body.[a]		
37. sleep better.[a]		

Physical Activity Outcomes

Use this scale to tell us if you agree the following will happen:

1	2	3	4	5
Strongly Disagree				Strongly Agree

Use this scale to tell us how much it will matter:

1	2	3	4	5
It will not matter at all				It will matter very much

If I slowly and steadily build up my daily step count I will ...	Do you agree? (1-5)	Will it matter? (1-5)
38. have less time to spend with my family.[b]		
39. feel refreshed.[a]		
40. fit into my clothes better.[a]		
41. manage my weight better.[a]		
42. feel less stress.[a]		
43. get too sweaty.*		
44. have something I can do with my family.*		
45. have less time to spend with my friends.[b]		
46. not like all the extra walking.*		
47. have more energy.[a]		

* Items were eliminated based on factor analysis

[a] Positive Outcome Expectancy Items

[b] Negative Outcome Expectancy Items

Step-Count Intentions

Please, tell us what you plan to do in the ***next few months*** to increase your step counts and physical activity.

Use the following scale to tell us if you agree that you will do the following

1 Strongly Disagree	2 Somewhat Disagree	3 Neither Agree nor Disagree	4 Somewhat Agree	5 Strongly Agree

In the NEXT FEW MONTHS I will . . .	Disagree or Agree: (1-5)
11. set aside time each day to increase my daily step-count or physical activity.	
12. take the stairs instead of an elevator.	
13. write down in my calendar my plans to increase my daily step-count or physical activity.	
14. if the weather is bad plan other places to increase my daily step-count or physical activity	
15. keep track of how many steps I am taking.	
16. walk instead of drive when going out for lunch or doing errands*	
17. find or hire a babysitter so I can increase my daily step-count or physical activity*	
18. take short breaks during the day to increase my daily step-count or physical activity.	
19. park farther away from school or work to increase my daily step-count or physical activity.	
20. get together with someone else to increase my step-count or physical activity.	
21. slowly and steadily increase my step counts.	
22. increase my step counts by 500 per day each week for 8 weeks.	

* Items were eliminated based on factor analysis

Physical Activity Satisfaction

Please tell us about your satisfaction with these things that have changed *as a result of your physical activity*.

Use this scale to tell us how satisfied you are

1 Very Dissatisfied	2 Somewhat Dissatisfied	3 Neither Satisfied or Dissatisfied	4 Somewhat Satisfied	5 Very Satisfied

AT THIS TIME I am satisfied with these things that have changed *as a result of my physical activity* . . .	How Satisfied? (1-5)
48. my normal routine.[a]	
49. my mood.[a]	
50. the time it takes to plan my day.[b]	
51. the way I feel about my body.[a]	
52. the amount of time I have to do other things.[b]	
53. the amount of muscle soreness I feel.[a]	
54. my quality of sleep.[a]	
55. the way my clothes fit.[a]	
56. my weight management.[a]	
57. my stress level.[a]	
58. the time I have to spend with my family.[b]	
59. the time I have to spend with my friends.[b]	
60. the amount of energy I have.[a]	
61. my life.[a]	
62. the amount of physical activity I am getting.[a]	

[a] Items loading on $PS_{General}$

[b] Items loading on PS_{Time}