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Interpersonal Influence on Physical Activity:

Mediation by psychological factors

and moderation by personal characteristics

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**Interpersonal Influence on Physical Activity:
Mediation by psychological factors
and moderation by personal characteristics**

by

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To my family, friends, and teachers for their support, acceptance, and inspiration;
to my parents for encouraging my love of learning;
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to Jane for her steady support and help through many years of striving.

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Over the past 20 years I have benefited from an extended academic family. My initial foray into graduate school was supported by a number of faculty and fellow

students at Texas Tech University in Lubbock, Texas. There is no doubt that the support, encouragement, and stimulation that I received during my time at Texas Tech showed me how rewarding, challenging, and, therefore, desirable, work in academia could be. This awareness fueled my return to graduate school in more recent years.

Oliver Hensley's courses in Higher Education provided me with a thoughtful window into the world of higher education and the encouragement to pursue my own ideas rather than to rely solely on those belonging to others. At the same time he introduced me to the benefits of collegial cooperation with a wonderful group of peers including Fred Sallee, Herlinda Coronado, Ken Tunstall, and Pam Fedler-Cooper.

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My return to graduate school at the University of Texas at Austin has given me an opportunity to pursue the intersection of my intellectual interests and work in the service of society. The architect of these opportunities has been my advisor, Nell Gottlieb. Her guidance has allowed me to vigorously pursue my intellectual interests, expand my academic skill set, and become more employable, all within a reasonable period of time. She has demonstrated a commitment to the quality of my educational experience from the beginning and did not waver in her support, which she expressed through the broadest range of academic skills imaginable. I am fortunate to have worked with her and deeply grateful for her help.

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This dissertation has its roots in a lecture given by Rafer Lutz of Baylor University. His discussion on the relationship between the descriptive norm and physical activity brought together two topics of greatest interest to me and that have served to focus this dissertation work. I am grateful for his visiting lecture that has become more clearly on target with the publication of the research of Christakis and Fowler in 2007.

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My advanced age at graduation has made possible the closing of a circle with my children. My daughter, Hana, was only four when I entered graduate school for the first time and my son, Daniel, was not yet born. As I complete the educational process 20 years later, they are both capable of discussing world events, my work, their work, and the state of the world. There is something of coming of age for all of us in this experience and I feel so lucky that I have them to share my past, present, and future as we enter this uncertain time in our national and personal histories. My family is truly my haven in a sometimes, but not always, heartless world.

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Interpersonal Influence on Physical Activity:

Mediation by psychological factors and

moderation by personal characteristics

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The University of Texas at Austin

Supervisors: Nell Gottlieb and Laurence Chalip

The primary purpose of the study was to identify relationships among sources of personal influence, putative psychological mediators, and physical activity. The moderation of these relationships by age, body composition, and educational attainment was also evaluated.

Responses from 1224 employees were collected through an online survey at a major healthcare facility in central Texas. Structural equation modeling was used to construct the Social Context Scale of Interpersonal Influence and to estimate its ability to explain intention to be physically active and predict physical activity behavior. Invariance testing provided estimates of moderation by age, education, and body composition.

Home social context was positively associated with self-efficacy and positive anticipated outcomes and negatively associated with negative anticipated outcomes. Friend social context was positively associated with self-efficacy, positive anticipated

outcomes, and intention. Teasing was positively associated with negative anticipated outcomes. Self-efficacy and positive anticipated outcomes were positively associated with intention. Negative anticipated outcomes were negatively associated with intention. The relationship between friend social context and both positive anticipated outcomes and intention was stronger for obese than non-obese respondents. Home social context was more strongly associated with self-efficacy for those with four year degrees than for those without. Self-efficacy was more strongly associated with intention for those with four year degrees than for those without. Self-efficacy predicted subsequent total leisure time physical activity and the relationship was stronger for respondents over 45 years of age than for those younger than 45. The association between self-efficacy and subsequent total leisure time physical activity was also stronger for respondents with a four year degree than for those without.

Home and friend social contexts provide potential conduits for post intervention influence on physical activity behavior. The discussion of the benefits of physical activity among friends may encourage overweight and obese individuals considering exercise, especially those with limited physical activity experiences of their own.

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CHAPTER 1

INTRODUCTION

The Problem

Christakis and Fowler (2007) found that the friends of individuals who became obese were more likely to become obese themselves at a future time than were friends of non-obese individuals. Obesity is associated with a number of chronic diseases including cardiovascular disease, diabetes, and some cancers (Centers for Disease Control, 2009). Physical activity is a key factor in weight loss and subsequent weight maintenance for obese and overweight individuals (National Institutes of Health, 1998). Understanding the role that interpersonal influence plays in physical activity patterns could provide insight into producing interventions that are able to promote physical activity in people who are or who could become sedentary. Considerable research has explored interpersonal influence as a factor in physical activity behavior. This study will attempt to advance the development of our existing knowledge on the subject.

Existing Theory and Research

Most physical activity research in the last 20 years has been organized around two dominant theories of health behavior – the Social Cognitive Theory (Bandura, 1986) and the Theory of Planned Behavior (Ajzen, 1991). In 1991 the National Institutes of Health sponsored a health behavior conference to identify key health behavior determinants that could be addressed in the battle against HIV/AIDS. The conferees included many of the leading health behavior theorists and thinkers of the time, including authors of these and

related theories. Their theoretical synthesis (Fishbein, 1995) identified eight behavioral determinants – three proximal and five distal – that could be used to explain health behaviors. The proximal determinants included intention, the skills needed for behavioral performance, and environmental constraints that might preclude the performance of the behavior. The distal determinants influenced the proximal ones and included self-efficacy, anticipated outcomes, norms, self-standards, and emotional reactions regarding the behavior. Figure 1.1 presents a graphic representation of the relations among these factors.

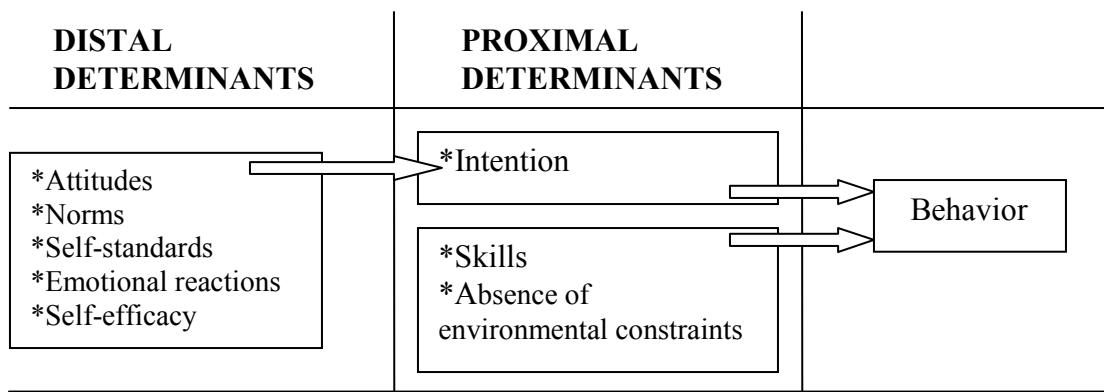


Figure 1.1 Determinants of health behavior. Based on Fishbein (1995).

A large proportion of physical activity research has employed analogues of these determinants, especially, intention, self-efficacy, and anticipated outcomes. Intention and self-efficacy have both been consistently found to be associated with physical activity by many researchers (Troost et al., 2002; Sallis & Owen, 2000). More recent studies find that the intention - behavior association is independent, except in cases in which prior behavior was included in the analytical model (see Norman et al., 2000, for an example).

The same is true for self-efficacy; while there are some instances in which it is not independently associated with physical activity (see Rovniak et al., 2002), there are many in which it is (see Norman et al., 2000). Anticipated outcomes is typically associated with physical activity at the bivariate level (such as Cardinal et al., 2004), but very seldom when analytical models include intention (Plotnikoff et al., 2008).

A number of scholars (Smith and Biddle, 1999; Okun et al., 2002 & 2003; Rovniak et al., 2002) have differentiated the causal sequence of the distal determinants described in Figure 1.1 above, placing interpersonal factors prior to the psychological factors self-efficacy and anticipated outcomes. The studies reported here draw on this approach as well, as it seeks to study possible patterns of interpersonal influence on the putative, proximal determinants of behavior.

The factors used to assess interpersonal influence are still in question. It has been well established that social support is associated with physical activity (Trost et al., 2002; Marshall & Biddle, 2001). The role played by social norms in the prediction of physical activity is less clear. Social norms in physical activity research were originally conceptualized as the injunctive norm which addresses the extent to which an actor perceives that his significant others think he should perform the behavior in question. The injunctive aspect of social norms has been found to be inconsistently associated with physical activity (Trost et al., 2002; Sallis & Owen, 1999) and may be a better predictor of the performance of negatively sanctioned behaviors (Reno, Cialdini, & Kallgren, 1991) such as criminal activity. More recently researchers have used the descriptive aspect of the subjective norm as a putative determinant in physical activity research

(Okun et al., 2002; Okun et al., 2003; Ravis & Sheeran, 2003). The descriptive norm refers to an actor's perceptions of what the people in his environment do with respect to the behavior in question.

The studies of social support and the descriptive norm have tended to focus on the influence of friends and family, with some success. Drawing on the studies of Cialdini and colleagues (1990), it may be useful to also evaluate the influence of others in the environment who are not as well known to the central actor, but whose behavior is observable. Some community based studies (Booth et al., 2000; King et al., 2000) have analyzed the impact of the observation of non-specific others being active with mixed results. These studies have focused on physical activity behavior alone, but Heise (2006) notes that topics of discussion can also influence peoples' behavior and should, therefore, be considered part of the normative environment. It follows that interpersonal influence, on the whole, includes both exchange relationships (Emerson, 1992), such as are involved in social support, and social learning (Bandura, 1986) from observation of norms for behavior and behavior related speech.

This Study

The three studies reported here tested a broad set of potential interpersonal influences for their association with physical activity behavior. In order to more nearly exhaust the range of possible social contexts from which influence flows, interpersonal influence was assessed in friend, home, and occupational contexts. Perceptions of the physical activity behaviors and physical activity-related speech were evaluated to address potentially influential aspects of social norms for physical activity within each social

context. Similarly, two forms of social support – companionship for physical activity and encouragement to participate in physical activity – were assessed across each of the three social contexts.

The associations between these forms of influence and the putative psychological mediators self-efficacy, anticipated outcomes, and intention were assessed to better understand if their manipulation can serve as mechanisms through which people may be moved to initiate and maintain regular physical activity behavior. Because differences in personal characteristics lead to different life experiences, goals, etc; the patterns of mediation identified above will be tested to see if they vary from one subpopulation to another. The data available for this study supported the analysis of differences across age, education, and body composition. Figure 1.2 presents the model tested in this study.

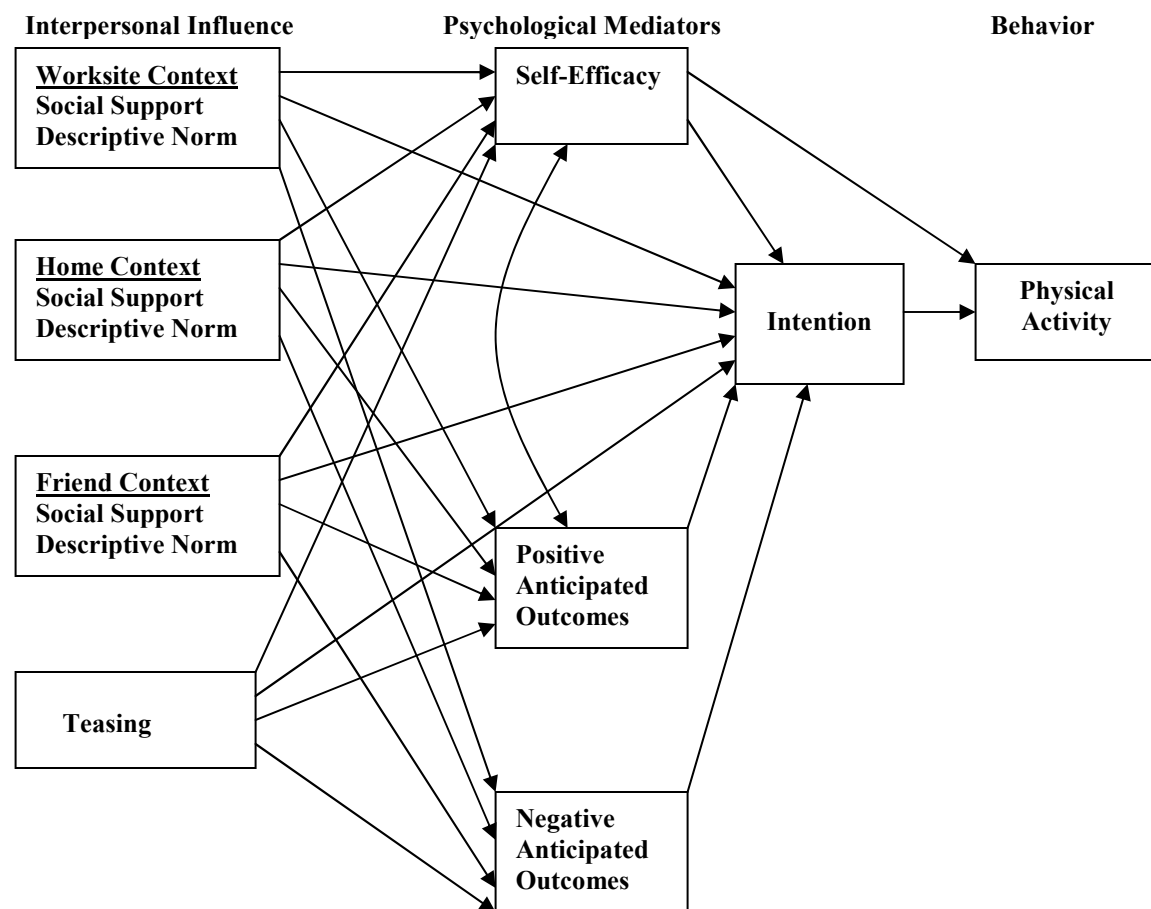


Figure 1.2 The Social Context Model of Adult Physical Activity

Hypotheses

This research project is composed of three studies, each focused on a number of specific hypotheses.

1. Study one regarding the modeling of interpersonal influences:

H1. A three factor measurement model based on the factors “home social context,” “work social context,” and “friend social context” will fit the data better than a single factor model based on “interpersonal influence” or a two factor model based on “social support” and the “descriptive norm.”

H1a. The three factor model RMSEA values will be below .05 and these will be the lowest among all baseline confirmatory factor models. Probability of good fit will be greatest for the three factor model.

H1b. The three factor model will have SRMR values below .10 and these will be the lowest among all baseline confirmatory factor models.

H1c. The three factor model will have CFI values above .90 and these will be the highest among all baseline confirmatory factor models.

H1d. The Aikake Information Criteria values for the three factor model will be the lowest among all baseline confirmatory factor models.

H1e. The bivariate correlations between factors in the three factor model will not exceed .85.

H1f. The scales from the three factor model will have Chronbach alpha values in excess of .70.

2. Study two regarding the association between interpersonal influence and intention to participate in physical activity:

H2a. Social context factors assessing interpersonal influence will be positively and independently associated with self-efficacy and anticipated outcomes.

H2b. Teasing will be negatively and independently associated with self-efficacy and anticipated outcomes and positively and independently with negative anticipated outcomes.

H2c. Factors assessing interpersonal influence will not be independently associated with intention.

The relationships between interpersonal influence and all psychological factors will be explored for moderating effects by age, education, and body composition.

3. Study three regarding the association between interpersonal influence and energy expenditure from leisure time physical activity:

H3a. The association between interpersonal influence and energy expenditure from leisure time physical activity will be completely mediated by self-efficacy for physical activity, anticipated outcomes for physical activity, and behavioral intention for participation in physical activity.

H3b. Intention and self-efficacy will be positively and independently associated with physical activity.

All mediational relationships will be assessed for moderation by age, education, and body composition.

Definitions

Interpersonal Influence – consistent with Raven’s definition of social influence, a change in a person's cognition, attitude, or behavior, which has its origin in another person or group (Raven, 1964). The change may be motivated by an interpersonal exchange of resources or by the actor’s changing awareness of other behavior patterns that are commonly found at one or more levels of society. This definition excludes the influence of media, hence the use of the term “interpersonal.” In this study the term will refer to the putative impact of social support and/or the descriptive norm on cognition, attitude, or behavior.

Physical activity - Casperson and colleagues (1986:126) define physical activity as muscular activity that produces bodily movement. Physical activity can be observed in a variety of social (individual vs. group), intentional (fitness vs. enjoyment), and behavioral contexts (work vs. recreation), each of which could shape the patterns of relationship among the factors which determine participation therein.

Psychological constructs – variables that are representative of factors involved in decision making about future behavior. In this study, the constructs self-efficacy for barriers to physical activity, anticipated outcomes for physical activity and intention to participate in physical activity are employed.

Intention to participate in physical activity – a belief about one’s future “performance of a given behavior” (Fishbein, 1978:378) or the “...determination to perform certain activities or to bring about a certain future state of affairs.” (Bandura, 1986:467)

Self-Efficacy - Behavioral theories have generally come to include some concept that relates to an actor's sense of his/her ability to perform the behavior in question. Bandura has evolved as the leading spokesperson for this concept and he puts it thusly:

Perceived self-efficacy is defined as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses. (1986:391)

Perceived Behavioral Control – a person's "perceived ease or difficulty of carrying out a certain action" (Godin and Gagne, 2000; Cf. Okun et al., 2003). Perceived Behavioral Control is generally understood to reflect the extent to which a person perceives that they have the ability to perform the behavior (Glanz et al., 2002).

Anticipated Outcomes – A construct that includes both the expectations associated with behavioral performance and the values attached to those expectations. The term is borrowed from Fishbein and colleagues (2001:5) who use the term as an alternative to attitudes and outcome expectations.

Outcome Expectations – A two dimensional construct, including both benefits and the barriers to participation. Becker (1974) puts it this way:

...individual's evaluation of the advocated health action in terms of its feasibility and efficaciousness [i.e., his estimate of the action's potential 'benefits' in reducing actual or perceived susceptibility and/or severity], weighed against his perceptions of psychological and other 'barriers' or 'costs' of the proposed action (including the "work" involved in taking action)... (1974: 21-22)

Attitudes – bi-polar evaluative judgments (Fishbein, 1978) that encompass instrumental (beneficial and valuable, for example) and affective (such as pleasant and enjoyable) dimensions of experience.

Social Support – the “functional content of relationships...” (House, as cited in Heaney and Israel, 2002:186). Social support can be categorized into four types of supportive behaviors including emotional, instrumental, informational, and appraisal support.

Descriptive Norm – Lewis, DeVellis, & Sleath (2002:242) refer to the descriptive norm as “the way that most people act.” Heise (2006) describes both words and actions as aspects of behavior perceived by others to be normative.

Social Context – three different social contexts are differentiated in this study – occupational, home, and friend. These contexts are defined by the social statuses held by the actors and the roles they perform in various physical settings.

MET - is a unit used in describing the energy expenditure associated with a specific activity. A MET is the ratio of the rate of energy expended during an activity to the rate of energy expended at rest (United States Department of Health and Human Services [USDHHS], 2008).

Significance of the study

Fishbein (1995) noted that while influencing behavior is of primary importance for those who plan to be active, it is equally important to influence the behavioral intentions of those who lack such plans. Fishbein notes that this change is generally accomplished by increasing self-efficacy, anticipated outcomes, and other factors that are causally prior to intention. These studies were an attempt to clarify the patterns of association between interpersonal factors and psychological factors through which increases in behavioral intention can be triggered. They also attempted to identify unique patterns of association between interpersonal factors and psychological mediators that predict energy expenditure through leisure time physical activity. Along with the development of a general model of associational patterns among these variables, this research should also help facilitate the development of interventions for specific sub-populations, in particular those defined by age, education level, and body composition.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

Rather than rely on a single theory, this study will offer a synthesis of theory based work which takes as its starting point a statement on the findings of a conference convened by the National Institutes of Mental Health in 1991. In his summary of conferee findings on the theoretical underpinnings of health behaviors, Martin Fishbein (1995) wrote

To summarize briefly, intention, skills, and the absence of environmental constraints are viewed as necessary and sufficient for producing any behavior. In contrast, attitudes, norms, self-standards, emotional reactions, and self-efficacy are viewed primarily as influencing the strength and direction of intention, although they also may have a direct influence upon behavior. (1995:251)

A graphical summary of this statement is presented in Figure 2.1

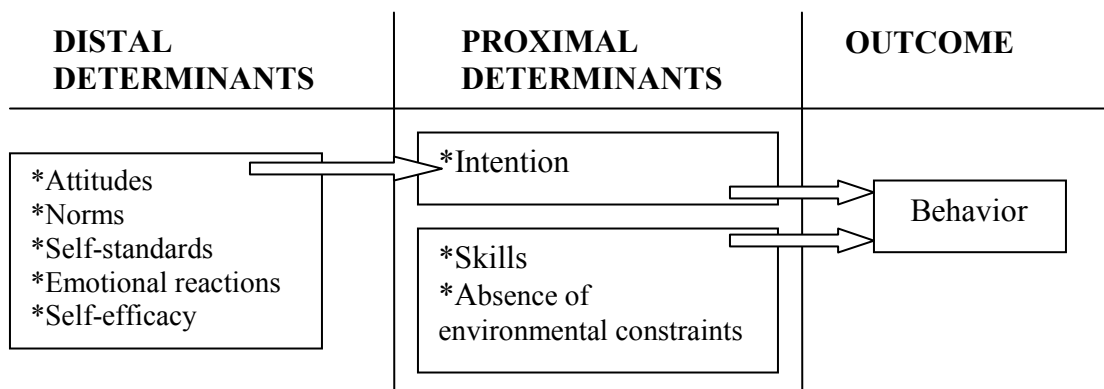


Figure 2.1 Determinants of health behavior. Based on Fishbein (1995).

Fishbein goes on to make clear the importance of determining if the primary goal of the intervention is to modify behavior or to modify behavioral intention.

Clearly, very different interventions will be necessary if a person (or group) has not yet developed a strong intention (or made a commitment) to perform a given behavior, than if the person has formed a strong intention but is unable to act on it. For example, if a person has formed a strong intention to perform a given behavior but is not acting upon that intention, the intervention should be focused upon improving skills or removing or helping one to overcome environmental constraints. ***In contrast, if a person has not yet formed a strong intention to perform a given behavior, the goal of the intervention should be to strengthen the person's intention to perform that behavior. This could be accomplished by changing self-efficacy, outcome expectancies (or attitudes), norms, self-standards, or emotions vis-à-vis that behavior.*** (emphasis mine) The issue then becomes choosing which variable to target in the intervention. (1995:252)

The work of Fishbein and colleagues provides a well informed starting place for theoretical elaboration. More recently, Fishbein (Montano & Kasprzyk, 2008) has presented the Integrated Behavioral Model which seeks to integrate a factor from the NIMH conference into (self-efficacy) a Theory of Planned Behavior Framework, as well as introduce external factors (knowledge and skills, salience of the behavior, environmental constraints, and habit) which impact behavior beyond the influence of behavioral intention. Their work is a significant advance from the Theory of Planned Behavior and captures many of the concepts presented in the NIMH model.

Like the Theory of Planned Behavior, the Integrated Behavioral Model suffers from the specification of normative influence as an independent determinant of behavioral intention. This contradicts the implications of Social Learning Theory

(Bandura, 1986). Actors are understood to learn behaviors from others. They will subsequently develop and revise perceptions of self-efficacy and value associated with those behaviors. This understanding places normative influences as causally prior to personal agency and attitude (constructs from the Integrated Behavioral Model) and opens the door to a mediational model of interpersonal influence on intention and behavior.

The model developed in this study is based on the assumption that people operate as self-regulating systems involved in controlling various factors in their environments (Powers, 1973; Carver & Scheier, 1998). In so doing, they form goals and employ resources in behavioral programs intended to reach those goals. This behavior pattern proceeds in a cyclical manner in which interactions with the environment yield regularly revised understandings of the salience of goals and the efficacy of behaviors in reaching those goals. This set of assumptions provides the basis for a theoretical model that specifies perceptions of the social environment as causally prior to perceptions of self-efficacy and anticipated outcomes, which are, in turn, prior to behavioral intention, and, finally, behavior.

Fishbein and colleagues (1995) were clearly trying to speak in a general way regarding the factors influencing behavior, but two points need to be made regarding interpersonal factors in the model. The first concerns social norms. Both existing literature reviews (Troost et al., 2002; Sallis & Owen, 1999; Godin & Kok, 1996) and more recent research (Okun, Karoly, & Lutz, 2002) have made clear that the injunctive norm included in formulations of the Theory of Planned Behavior does not predict

physical activity behavior. On the other hand, the descriptive norm appears to have some promise (Okun et al., 2002 and Okun et al., 2003; Ravis & Sheeran, 2003a & 2003b). A second point concerns the absence of social support in Fishbein's theoretical synthesis. The association between social support and physical activity is well documented in the literature (Trost et al., 2002; Sallis & Owen, 1999; Marshall & Biddle, 2001) and cannot be ignored as a form of interpersonal influence on physical activity. Accordingly, these two features of the social environment will be considered in this study and are specified as components in the theoretical model in Figure 2.2 below.

Personal characteristics such as age, race, sex, and education shape social outcomes by virtue of their impact on exchange relations and interpretation of social roles (Bandura, 1989). It follows that they may also impact, directly or through social interactions, physical activity behavior. The general model resulting from this analysis is presented in Figure 2.2 below and provides the structure for this review of literature.

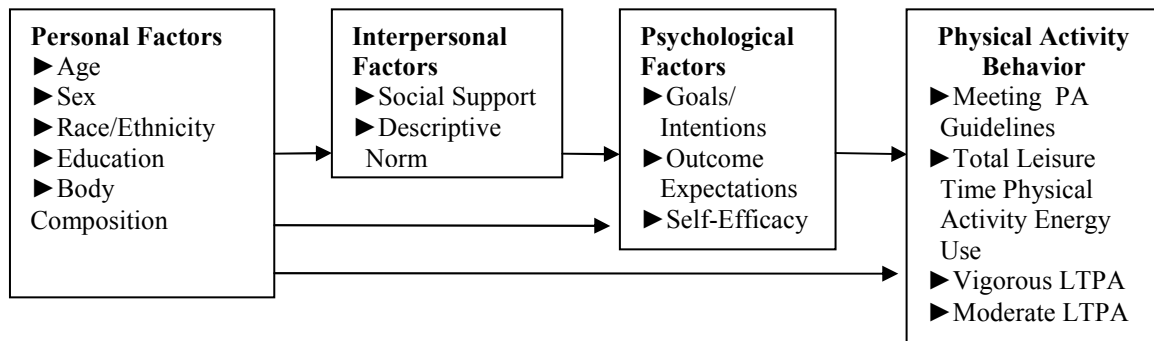


Figure 2.2. Factors evaluated in the literature review.

This literature review will consider three types of factors for their associations with physical activity and its determinants – personal characteristics, psychological factors and interpersonal factors. The existence of a relationship between personal characteristics and physical activity levels will be judged on the basis of recent data from a survey of US adults. No attempt will be made to establish the type of association (independent or otherwise) as it is beyond the scope of this study. In the cases of psychological and interpersonal factors, evidence will be assessed to determine if the association is independent or not because that outcome will determine the structure of the apriori model to be developed. In the case of all factors, associations are positive unless otherwise noted.

Associations Between Physical Activity and Personal Characteristics

The first set of factors includes personal characteristics that can be readily used to define target populations for physical activity promoting interventions. This review will evaluate the associations between sex, race/ethnicity, age, education, and body composition, on one hand, and physical activity behavior on the other. By their associations with social roles, personal resources, and environmental challenges, these characteristics tap into the individual-environment interplay (Bandura, 1986) that shapes behavior. To the extent that these factors are associated with physical activity levels, they represent potential analytical levers for understanding behavior and creating more effective, subpopulation specific interventions.

The most current data on physical activity in the US come from the 2007 CDC/BRFSS survey. The survey provides estimates of the proportions of the population which are meeting the guidelines from the American College of Sports Medicine – ACSM, hereafter - (2009). The ACSM recommends that adults get 30 or more minutes of moderate physical activity on five or more days per week, or vigorous physical activity for 20 or more minutes on three or more days per week. The survey also documents the percentage of respondents who meet the guidelines through vigorous activity alone. There is considerable variation across sociodemographic factors in the extent to which US citizens meet these recommendations as of 2007 (CDC, 2007). Some of these differences are described below.

Age

Data from the most recent BRFSS survey describe a generally linear decrease in physical activity as people age. While 60.9% of 18-24 year olds report meeting physical activity guidelines, only 39.3% do so at age 65 and beyond. There is a parallel decline in rates of vigorous activity reported as well. Eighteen to twenty four year olds report three or more days of at least 20 minutes of vigorous activity weekly at a rate of 42.7%. This falls to 14.9% in those 65 years and over. Table 2.1 presents these data in numeric form.

Table 2.1 Percentage meeting physical activity guidelines
by age category.^a

Age:	Meeting Guidelines ^a % in Median State (# states responding)	Vigorous PA only % in Median State (# states responding)
18-24	60.9 (47)	42.7 (47)
25-34	55.0 (51)	33.9 (51)
35-44	51.9 (51)	31.2 (51)
45-54	48.9 (51)	27.5 (51)
55-64	47.5 (51)	22.1 (51)
65+	39.3 (51)	14.9 (51)

a. Includes those who meet guidelines through either moderate or vigorous activity

Sex

Based on 2007 data, US adult males report meeting physical activity guidelines with greater frequency than do females (51.5% to 47.5%, respectively). Men are more likely to engage in vigorous physical activity than women by a wider margin (32.9% to 23.8%, respectively). Table 2.2 presents these data in numeric form.

Table 2.2 Percentage meeting physical activity guidelines by sex.^a

Gender:	Meeting Guidelines^a % in Median State (# states responding)	Meeting Guidelines through Vigorous PA only % in Median State (# states responding)
Male	51.5 (51)	32.9 (51)
Female	47.5 (51)	23.8 (51)

a. Includes those who meet guidelines through either moderate or vigorous activity.

Race/Ethnicity

Physical activity varies by racial/ethnic identity. Those self-described as white, non-Hispanic report meeting the physical activity guidelines at a rate of 51.6%. Survey respondents classified as “Other” report meeting guidelines at the next highest rate, 49.0%. Hispanic respondents reported meeting guidelines at a rate of 44.7% and Black respondents reported meeting guidelines at the lowest rate, 41.4%. The same pattern exists for participation in vigorous physical activity three or more days per week for at least 20 minutes/day. White respondents report meeting these vigorous activity guidelines at a rate of 29.1% while those classified as “Others” did so at a rate of 28.1%.

Hispanics reported meeting the standard for vigorous activity at a rate of 24.9% and Black respondents at a rate of 23.7%. These findings are summarized in Table 2.3.

Table 2.3 Percentage meeting physical activity guidelines by racial/ethnic category.

Race:	Meeting Guidelines for Moderate and/or Total Physical Activity % in Median State (# states responding)	Meeting Guidelines for Vigorous PA only % in Median State (# states responding)
White	51.6 (51)	29.1 (51)
Black	41.4 (30)	23.7 (31)
Hispanic	44.7 (26)	24.9 (30)
Other	49.0 (19)	28.1 (22)

Education

The level of educational attainment is positively associated with the proportion of respondents in that category who report meeting physical activity guidelines. Those without a high school education report meeting the guidelines at a rate of 40.2%, while those with college degrees report doing so at a rate of 53.8%. The same relationship holds with respect to educational level and the rates of reporting three or more days per week of vigorous physical activity for at least 20 minutes daily. Those without a high school diploma (or GED) reported meeting guidelines at a rate of 18.5%, compared to those with college degrees, who report doing so at a rate of 33.6%. The variation in meeting physical activity guidelines by educational level is summarized in Table 2.4.

Table 2.4. Percentage meeting physical activity guidelines by level of education.

Education:	Meeting Guidelines for Moderate and/or Physical Activity % in Median State (# states responding)	Meeting Guidelines for Vigorous PA only % in Median State (# states responding)
Less than H.S.	40.2 (49)	18.5 (50)
H.S. or G.E.D.	46.1 (51)	24.3 (51)
Some post-H.S.	50.6 (51)	28.4 (51)
College graduate	53.8 (51)	33.6 (51)

Body Composition

The 2007 BRFSS data do not include information about variation in physical activity by Body Mass Index, as they formerly did. The 1996 survey did report this information. These data reflect an inverse relationship between body mass and physical activity level for all measures, including inactivity, vigorous and moderate activity, and those meeting physical activity recommendations. The differences between categories are most pronounced between those self-reporting as overweight and those who self-report as obese. From the data it is clear that obesity is associated with dramatically higher levels of inactivity and lower levels of moderate and vigorous activity. Table 2.5 presents these data numerically.

Table 2.5 Physical activity by Body Mass Index Category

BMI	Inactive	Vigorous	Moderate	Recommended
<25	27.3%	14.6%	25.1%	30.1%
25-29.9	28.0%	12.1%	23.6%	27.8%
≥30	37.0%	7.6%	18.2%	21.0%

Associations Between Physical Activity and Psychological Factors

The second set of factors that will be evaluated are those psychological determinants of behavior common to decision making analysis – perceptions of behavioral capability, perceptions of potential behavioral outcomes, and behavioral goals or intentions. These factors are commonly used in the three dominant approaches to understanding health behavior, in general, and physical activity, in particular, – the Theory of Planned Behavior (Ajzen, 1991) and Social Cognitive Theory (Bandura, 1986), and the Transtheoretical Model (Prochaska, Redding, & Evers, 1994).

The psychological factors in this model constitute much of the decision making process and its result. Self-efficacy and anticipated outcomes are sets of information that could be considered inputs in the decision making process, whereas behavioral intention is the output. Figure 2.3 depicts the relationships that will be evaluated in the following review of literature concerning psychological factors.

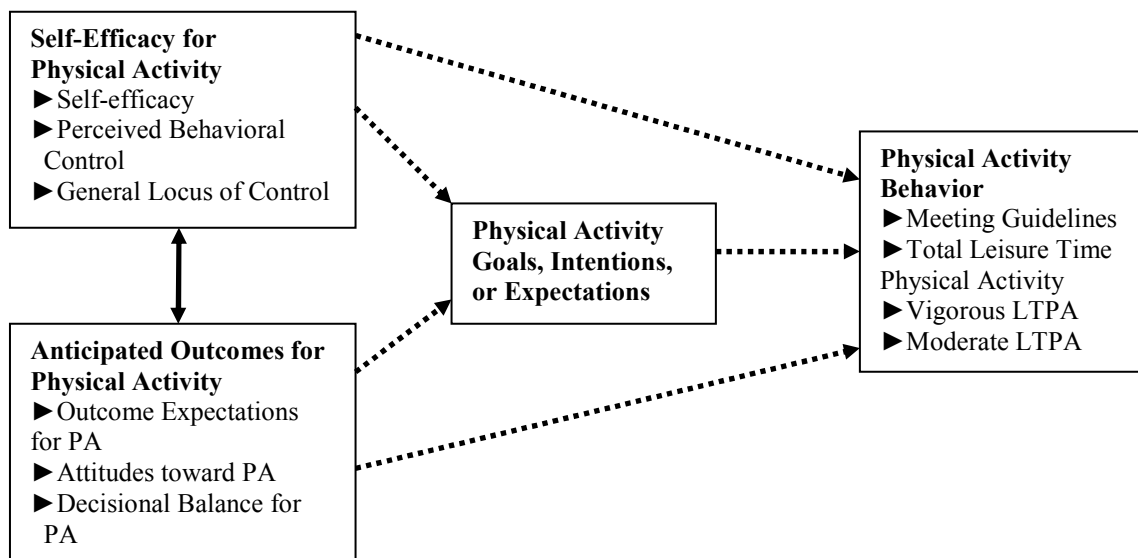


Figure 2.3 Potential relationships among psychological factors and physical activity behavior.

Intention to Participate in Physical Activity

Theoretical Basis

Fishbein describes behavioral intention as a belief about one's future "...performance of a given behavior ..." (1978:378). For Bandura, it is the "...determination to perform certain activities or to bring about a certain future state of affairs" (Bandura 1986:467). In this sense, intention is seen as an output of a decision making process based on a variously defined set of conditions. As Fishbein notes, intention is not an "on/off variable" (p.9), but rather represents a continuous variable that varies in terms of strength and intensity.

Rhodes and Matheson (2005) distinguish between intention and expectation. They cite (p.64) Warshaw and Davis' definition of behavioral intention as "the degree to which a person has formulated conscious plans to perform or to not perform some specified behavior" (1985:250). On the other hand, expectations include an element of likelihood assessment. To the extent that such assessments are accurate, it seems probable that expectation – behavior associations will be stronger than will intention – behavior associations. Furthermore, the inclusion of probability estimates points to the potential for stronger associations between self-efficacy and expectation than for self-efficacy and intention.

With its emphasis on self-regulation, Social Cognitive Theory makes behavioral intention a key concept in a comprehensive behavioral model. Typical conceptualizations employ either goals alone or with other constructs. Rovniak and colleagues (2002) use both goals and plans and Plotnikoff and colleagues (2008) use goals. In both of these

cases the behavioral intention construct is seen as being determined by a combination of self-efficacy and anticipated outcomes (outcome expectations).

Findings

In general, recent research findings indicate that behavioral intention is independently associated with physical activity behavior. This finding is based on 16 published research reports, including one literature review and one report that presented results from two studies.

Trost and colleagues (2002) provided an updated review of research reported between 1998 and 2000 on the factors associated with physical activity. They found that “intention to exercise” was consistently and positively associated with physical activity behavior in six studies published during the period covered by their review. They noted that this result was consistent with the findings of Sallis and Owen’s 1999 review.

The results from regression analyses performed in 15 studies (14 not included in the previously mentioned reviews) paint similar pictures. Two studies employed structural equation models based on social cognitive constructs. Plotnikoff and colleagues (2008) found that goals for physical activity were independently associated with leisure time exercise for both Type I ($b = .17, p < .01$) and Type II ($b = .11, p < .01$) diabetics in a model that also tested the independent association of positive outcome expectations with physical activity. In a study of US college students, Rovniak and associates (2002) found that the latent factor “self-regulation” (composed of goals and plans) was independently associated with physical activity ($b = .48, p < .05$) in a model that also tested for associations between both outcome expectations and self-efficacy with

physical activity. Smith and Biddle (1999) and Courneya and McAuley (1995) employed path analysis, albeit with Theory of Planned Behavior constructs. In two studies that assessed the direct association only between the intentions and physical activity behavior of UK health club members, Smith and Biddle (1999) found direct associations in both cases, ($b=.36$ and $b=.33$). Using a similar model that tested for a direct association only between intention and attendance at an exercise class, Courneya and McAuley (1995) found a positive result ($b=.51$).

Six reports described positive associations between behavioral intention and a measure of physical activity. Courneya and associates (2000) found a direct association between intention and stage of change for physical activity ($b=.47$, $p < .001$) in a study of Canadian adults. Their regression model included perceived behavioral control, attitude, and social support. Skar and associates (2008) found a direct association ($b=.11$, $p < .01$) when testing a multiple regression model that included intention certainty, in addition to intention. Courneya and colleagues (2006) studied Canadian college students in their assessment of the predictive validity of various scales representing constructs from the Theory of Planned Behavior. They found an independent association between intention and leisure time exercise ($b=.43 - .58$, $p < .001$) in each of five models that also included perceived behavioral control.

Rhodes and Matheson (2005) studied Canadian college students and found that intention was independently associated with leisure time exercise ($b=.39$, $p < .01$) when testing a model that included both intention commitment and perceived behavioral control. Okun and associates (2002 and 2003) studied US college students and found

independent associations between intention and leisure time exercise in both cases ($b=.12, p < .05$ and $b=.19, p < .05$, respectively). Models tested in both cases included perceived behavioral control, attitude, and descriptive norm.

Three studies reported models that failed to find a direct association between behavioral intention and leisure time exercise. Lowe and colleagues (2002) tested two such models. While they found an independent association between intention and exercise when testing a model that included perceived behavioral control ($b=.20, p < .01$), this finding was not replicated with a model that included attitudes. This result is not consistent with the bulk of research reviewed, and it is worth noting that the bivariate correlation between intention and behavior was relatively low ($r=.27$) in the first place. The second model with a null result included previous behavior, a finding shared by Norman and associates (2000) and Jackson and associates (2005). In the latter case, a positive result ($b=.45, p < .001$) was reported for a model not including previous exercise behavior. Previous exercise behavior is the dominant explanatory variable in each of the cases involving null results. While this is not surprising from a prediction standpoint, it is not particularly helpful from an explanatory standpoint. For purposes of designing interventions, it would be more informative to assess those factors associated with change in behavior, which is not directly assessed in these last two analyses.

One other study presents a potential boundary condition on the association between behavioral intention and physical activity. Karvinen's research (2007) on endometrial cancer survivors found an interaction between age and intention in the prediction of leisure time exercise. Unfortunately, neither the direction nor the

magnitude of the interaction was reported in the manuscript reviewed for this report. It is also possible that this finding may be restricted to or amplified in populations involving medical conditions that could reduce energy levels on a chronic basis. The studies presented in this review are summarized in Table 2.6.

Summary

When considered among a typical universe of *psychological factors* used to explain behavior, the various constructs representing behavioral intention are reliable, independent predictors of physical activity. The studies reviewed here support this conclusion with near unanimity (the exception being Lowe's result regarding the moderating effect of attitude). The association is positive in sign and the magnitude varied from .12 to .51.

Table 2.6 Studies evaluating the association between behavioral intention and physical activity.

Reference	Construct	Sample	Dependent Construct	Finding
Norman, 2000	Intention	UK patients at health promotion clinics	Leisure Time Exercise	NS w/ PBC and prior behavior
Lowe, 2002	Intention	UK Adults	Leisure Time Exercise	B=.20, $p < .01$ w/PBC NS w/Attitude NS w/ Prior Behavior
Jackson, 2003	Intention, Desire, and Expectation	UK college employees	Leisure Time Exercise	B=.45, $p < .001$ NS w/ prior behavior
Plotnikoff, 2008	Expectation	Canadian Diabetics	Leisure Time Exercise	B=.17/.11, $p < .01$
Rovniak, 2002	Self-Regulation	US College Students	Stage of Change Energy Expend. # Activity Modes	B= .48, $p < .05$
Skar, 2008	Intention	UK college students	Leisure Time Exercise	w/intention certainty B=.15, $p < .01$
Karvinen, 2007	Intention	Endometrial cancer survivors	Leisure Time Exercise	B=.38, $p < .001$ Age x Intention interaction
Courneya, 2006	Intention	Canadian college students	Leisure Time Exercise	B=.47 - .58 $p < .001$
Rhodes & Matheson, 2005	Intention	Canadian college students	Leisure Time Exercise	B=.39, $p < .01$
Okun, 2003	Intention	US college students	Leisure Time Exercise	B=.19, $p < .05$ B= .24, $p < .001$
Okun, 2002	Intention	US college students	Leisure Time Exercise	B=.12, $p < .05$
Courneya, 2000	Intention	Canadian Adults	Stage of Change for Physical Activity	B=.47, $p < .001$
Smith and Biddle, 1999	Intention	Health Club Members	Attendance at Exercise Program	B=.36 (Path model)
Smith and Biddle, 1999	Intention	Review	Total Physical Activity	B=.33 (Path model)
Courneya, 1995	Intention	Exercise Class participants	Leisure Time Exercise	B=.51
Trost, 2002	Intention to exercise	Review of 6 Studies	n/a	Consistent, positive findings

Self-Efficacy for Physical Activity

Theoretical Basis

Self-efficacy is perhaps the most studied social cognitive concept in health behavior research because it is frequently found to be associated with health behaviors of interest. Bandura defines self – efficacy this way:

Perceived self-efficacy is defined as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses. (1986:391)

From this perspective, self-efficacy accounts for barriers to behavioral performances that are perceived by an actor.

Ajzen (2002) included the concept perceived behavioral control in the Theory of Planned Behavior. He describes perceived behavioral control as “beliefs about the presence of factors that may facilitate or impede performance of the behavior and the perceived power of these factors.” Ajzen included perceived behavioral control in the Theory of Planned Behavior to account for the absence of behavior by individuals who possessed intention, but less than total volitional control. He noted that the strength of the direct association between perceived behavioral control and behavior should be inversely related to the level of control which people, as a group possess. It follows that for behaviors over which control is ubiquitous, perceived behavioral control will contribute little to the prediction of behavioral performance.

Of many questions that exist regarding the relationship between physical activity and self-efficacy, two will be dealt with here. As noted previously, intention is generally

seen as mediating between self-efficacy and behavior. This may be true, however, partly because health behavior research has generally focused on physical activity as something systematic that people do for health benefits. It should be noted that a person with a high level of self-efficacy for physical activity might be more likely than a person possessed of a lower level of self-efficacy to engage in spontaneous opportunities for physical activity (play, on one hand, and a more vigorous approach to life tasks, on the other). This spontaneous behavior might constitute a considerable amount of the regular activity that people report in physical activity recalls. It would very likely account for some of what is considered to be an error term in evaluations of the intention – behavior relationship. While measures of self-efficacy might not directly assess it, estimates could reflect a self-evaluation that would facilitate participation in behavior that was not planned and, thus, not mediated by pre-meditated intention

There is another pathway through which self-efficacy could impact behavior. Those with higher self efficacy are more likely to have participated with some success in physical activity and are, therefore, more likely to have overcome barriers and realized the benefits that accrue to participation. It is entirely possible, then, that self-efficacy could impact intentional physical activity through anticipated outcomes for physical activity. This relationship is not generally tested in research based on the Theory of Planned Behavior, perhaps because it is at odds with the original model. On the other hand, tests of Social Cognitive Theory do sometimes assess this relationship, although this is more likely in path and full structural equation modeling in which all relationships

among core constructs are modeled. Rovniak and associates (2002) provide an example of this approach.

For purposes of this study, the relationship between self-efficacy and anticipated outcomes will be modeled as covariation between error terms, privileging neither term as a sole cause of the other and implying the presence of a common factor that influences both self-efficacy and anticipated outcomes. It is assumed here that one could begin either with a consideration of potential for success or value of success when engaged in a decision making process and then proceed to the other consideration. From this perspective, it is theoretically appropriate to model covariation.

Findings: Self-efficacy and physical activity

Trost and associates (2002) differentiate between perceived behavioral control and self-efficacy in their review of research spanning 1998-2000. Furthermore, they replicate the findings of Sallis and Owen (1999) who observed that “control over exercise” was associated with “weak or mixed evidence of positive association with physical activity. On the other hand, both reviews found that research on self-efficacy “repeatedly documented positive association with physical activity.” On the basis of these different findings, studies employing perceived behavioral control are reported separately from those employing self-efficacy constructs. The following review provides with a consideration of the tests of association reported in 33 studies reported between 1995 and 2007.

Studies employing the perceived behavioral control construct

Two studies employed the perceived behavioral control construct and found no association. Courneya and McAuley (1995) studied Canadian college students and found a non-significant correlation between perceived behavioral control and attendance at an exercise class. Jackson and colleagues (2003) similarly found no correlation between perceived behavioral control and leisure time exercise in employees of a college in the UK.

Three studies that employed perceived behavioral control found only bivariate associations. Smith and Biddle (1999) found correlations between PCB and strenuous physical activity ($r=.24$, $p < .01$) and total PA ($r=.26$, $p < .01$). Their path model including this relationship fit poorly; when it was dropped the model fit appreciably better. Lowe (2002) found a correlation between PBC and Leisure Time energy use ($r=.25$, $p < .01$) in their study of adults from the UK. When included in a regression model that included intention and attitude, PBC was not found to be significantly associated with leisure time exercise. Rhodes and associates (2006) found a moderate association ($r=.39$, $p < .01$) between PBC and leisure time exercise in Canadian college students. Because PBC did not contribute significantly to the explanation of variance in exercise in a structural equation model, it was dropped from the final model.

Six studies that assessed self-efficacy in terms of perceived behavioral control found an independent association between PBC and exercise while testing regression models that included behavioral intention. Most recently, Skar (2008) found that PBC was associated with leisure time exercise ($b= .32$ to $.38$, all $p < .01$) when analyzing a

series of models on data collected from a sample of college students in the UK.

Courneya and associates (2006) found that PBC was associated with leisure time exercise in two of five regression models including intention. Their study of Canadian college students attempted to identify optimal measures of psychological factors for use in Theory of Planned Behavior studies. Both models using seven point items measuring intention yielded a positive, independent association between PBC and exercise ($b=.19$, $p < .01$ and $b=.30$, $p < .01$).

Okun and colleagues (2002; 2003) found similar patterns of association between PBC and leisure time exercise in two studies of US college students ($b=.20$, $p < .001$ and $b=.16$, $p < .01$, respectively) while testing models that contained attitudes and behavioral intention. Courneya and associates (2000) found that PBC was associated with leisure time exercise ($b=.07$, $p < .001$) in a sample of Canadian adults. Finally, Norman and colleagues (2000) studied adult patients from health promotion clinics in the UK. They found an independent association between PBC and exercise, even when the model employed included both behavioral intention and past exercise behavior.

Studies employing the self-efficacy construct

Studies that use a self-efficacy construct typically do not test for independence from intention in the self-efficacy – physical activity relationship. This is especially true for evaluations of interventions based on the Social Cognitive Theory and the Transtheoretical Model. Exceptions to this rule are noted below.

Marshall and Biddle (2001) performed a meta-analysis of studies that employed the Transtheoretical Model in research on physical activity. They found that self-efficacy

for physical activity was significantly associated across all stage transitions. Subsequent to that, Ott and associates (2004) found no association between self-efficacy and weight lifting in breast cancer survivors.

Three studies found a bivariate association between self-efficacy and physical activity, but no independent association in regression analysis. Rovniak and associates (2002) fitted a structural equation model that included a significant path between self-efficacy and self-regulation and a non-significant path between self-efficacy and physical activity. Jackson and colleagues (2003) studied employees of a college in the UK. They found that self-efficacy was not independently associated with leisure time exercise when testing a model that included behavioral intention. Castro and associates (1999) found that self-efficacy was not independently associated with walking when testing a model that assessed the social support, barriers to physical activity and enjoyment of physical activity for ethnic minority women.

Eight studies reported a bivariate association between self-efficacy and physical activity but did not report multivariate tests of association. Booth and colleagues (2000) found an association between the leisure time energy expenditure of elderly Australians and their self-efficacy for physical activity. Leslie and colleagues found that self-efficacy was associated with classification as engaging in “sufficient physical activity” for a sample of Australian college students. In their study of breast cancer patients, Rogers and associates (2005) reported a correlation between daily energy use and both barrier self-efficacy ($r=.62$, $p < .02$) and task self-efficacy ($r=.77$, $p < .001$). Pinto and associates

(2001) studied older adults and found that while associated with physical activity, self-efficacy did not mediate intervention effects on it.

Four of these studies reporting only bivariate associations addressed the possibility of a relationship between self-efficacy and stage of change for physical activity. This includes studies of a small sample of mothers participating in the WIC program (Fahrenwald & Walker, 2003), a sample of US adults (Sarkin, Johnson, Prochaska, & Prochaska, 2001), Korean adults (Kim, Cardinal, & Lee, 2006), and Canadian adults (Plotnikoff, Hotz, Birkett, & Courneya, 2001). None of these studies reported multivariate tests of association.

An additional eight studies found an association between self-efficacy and physical activity when testing models that did not include a construct representing behavioral intention. Most recently, McAuley and associates (2007) studied an intervention in a population of elderly, initially sedentary adults. They found that self-efficacy measured during the second year of the program predicted total physical activity levels in the 5th year of the program ($b=.17$, p not reported). Gyurcsik and colleagues' 2004 study of female college freshman adjusting to college life reported an association between task self-efficacy and vigorous physical activity ($b=.37$, $p < .01$). Cardinal and colleagues (2003) tested a multivariate model that included self-efficacy and decisional balance as predictors of leisure time exercise among US college students. They found an association (multiple $r=.46$, $p < .001$) between self-efficacy and leisure time exercise. Sternfield and associates studied correlates of physical activity in a sample of US women. They found that high self-efficacy was associated with high levels of participation in

sports and exercise activities (OR=3.96, CI=2.92-5.38). DeBordeadhuij and Sallis (2000) found that self-efficacy was associated with leisure time physical activity across all ages and for both genders in a large sample of Belgian adults.

Appropriately enough, change in self-efficacy has been studied for its association with physical activity. Brassington and colleagues (2003) found that exercise class attendance by previously sedentary adults was associated with both baseline self-efficacy ($b=.24$, $p < .05$) and change in self-efficacy ($b=.28$, $p < .01$). Miller and colleagues (2002) found that change in self-efficacy was associated with a greater likelihood of meeting physical activity guidelines (OR=1.86, CI=1.46 – 3.58) in a study of mothers who were participating in the WIC program and had young children at the time.

Finally, Bennett and associates (2007) reported an association between self-efficacy and participation in physical activity for those participating in an intervention that attempted to promote physical activity, but not in the control group.

Three studies reported an association between self-efficacy and physical activity while also assessing the relationship between behavioral intention and physical activity. Plotnikoff and colleagues (2008) studied differences between Type I and II diabetics in a sample of Canadian adults. They found that self-efficacy for physical activity was independently associated with leisure time exercise for both Type I ($b=.22$) and Type II ($b=.19$) diabetics when testing a structural equation model that included a significant path between goals and physical activity. Karvinen and associates (2007) tested a regression model that predicted leisure time exercise among endometrial cancer survivors. They found that self-efficacy was independently associated with physical activity in a model

that included both attitude and intention as predictors. DuCharme and Brawley (1995) studied covariates of exercise class attendance in a sample of Canadian women. They found that scheduling self-efficacy at the start of the ninth week of the program was associated ($p=.02$) with exercise class attendance for the following eight weeks. Table 2.7 provides a summary of the studies addressing the putative association between both self-efficacy and perceived behavioral control constructs with physical activity. Seven studies failed to find independent associations between self-efficacy and physical activity, while nine studies report an independent association, even when testing models that included behavioral intention.

Table 2.7 Studies evaluating the association between self-efficacy and physical activity.

Reference	Construct	Sample	Dependent Construct	Finding
Ott (2004)	S-E	Breast Cancer Survivors	Strength Training Adherence	No Correlation
Courneya (1995)	PBC	Exercise Class Participants	Exercise Class Attendance	No Correlation
Jackson (2003)	PBC	UK College Employees	Leisure Time Exercise	No Correlation
du Charmé (1995)	Scheduling S-E	Canadian Women	Leisure Time Exercise	Association w/ $p < .02$
Lowe (2002)	PBC	UK Adults	Leisure Time Exercise	$r=.25, p < .01$ NS w/intention
Booth (2000)	S-E	Older Australian Adults	Active	$\chi^2 p = .001$
Sarkin (2001)	S-E	US Adults	Stage of Change for Physical Activity	t score sig $p < .001$
Leslie (1999)	S-E	Australian College Students	Sufficient Physical Activity	Positively associated with sufficient physical activity
Kim (2006)	S-E	Korean Adults	Stage of Change for Physical Activity	$r= .45 p < .01$
Rogers (2005)	Barriers S-E Task S-E	US Women in Breast Cancer Therapy	Total Physical Activity	$\rho=.62$ $\rho=.77$
Rovniak (2002)	S-E	US College Students	1. Stage of Change 2. Energy Expend. 3. # Activity Modes	$r=.35-.55 p < .01$ ns w/self-regulation & outcome expectations
Jackson (2003)	S-E	UK College Employees	Leisure Time Exercise	$r=.33 p < .01$
Castro (1999)	S-E	Initially Sedentary US Women	Walking	$r=.22 - .37$ Change in S-E not Independently Associated with Change in Walking
Smith (1999)	PBC	Health Club members	Leisure Time Exercise	$r=.26 p < .01$
Plotnikoff (2001)	Self-efficacy	Canadian adults	Stage of Change for Physical Activity	$t=1.66 - 4.29$ $p = .05 - .001$
DeBordeaudhuij (2002)	S-E	Belgian adults	Leisure Time Exercise	Significant for Men & Women in All Age Groups w/o Intention
Gyurcsik (2004)	Task S-E	New US university students	Vigorous Leisure Time Exercise	$b=.15 p < .01$ w/o Intention
Pinto (2001)	S-E	Sedentary US adults	Occupational and Leisure Time Activity	NS w/ Behavioral Processes & Decisional Balance

Table 2.7 continued Studies evaluating the association between self-efficacy and physical activity.

Reference	Construct	Sample	Dependent Construct	Finding
Miller (2002)	S-E	Australian young women with children	Meet physical activity guidelines	OR=1.86 (1.17-2.94) w/o Intention
Bennett (2007)	S-E ¹	Long term cancer survivors in US	Increase in regular physical activity	Associated with increase in activity at .05 level
McAuley (2007)	S-E	Older US Adults	Physical activity scale for elderly	r=.32-.34 p < .05
Cardinal (2003)	S-E	US adults with disabilities	Stage of change for exercise	Associated with all stages
Fahrenwald (2003)	S-E	WIC program participants	Stage of change for physical activity	Rho = .56 p < .01
Sternfield (1999)	S-E	US Women	Sports & Exercise / Active Living / Household & Care Giving /Occupational	OR positive & Significant for All
Brassington (2002)	Change in S-E	US older adults	Exercise adherence	b=.37 p < .01 w/o Intention
Plotnikoff (2008)	S-E	Canadian Diabetics	Leisure Time Exercise	b=.22/.19 p < .01 w/Intention
Skar (2008)	PBC ²	UK college students	Leisure Time Exercise	b=.44 p < .01 w/Intention
Courneya (2006)	PBC	Canadian college students	Leisure Time Exercise	b=.44-.58 p < .001 w/Intention
Okun (2002)	PBC	US college students	Leisure Time Exercise	b=.20 p < .001 w/Intention
Okun (2003)	PBC	US college students	Leisure Time Exercise (strenuous and total)	b=.16-.21 p < .01 w/Intention
Courneya (2000)	PBC	Canadian Adults	Stage of Change for Physical Activity	b=.08 p < .001 w/Intention
Norman (2000)	PBC	UK patients at health promotion clinics	Leisure Time Exercise	b=.36 p < .05 w/Intention & Prior Behavior
Karvinen (2005)	S-E	Endometrial cancer survivors	Leisure Time Exercise	b=.18 p < .03 w/Intention

1. S-E = Self-efficacy

2. PBC = Perceived behavioral control

Summary: Self-efficacy and physical activity

This summary considers an overall assessment of the association between all constructs subsumed under self-efficacy and physical activity, as well as differences between the constructs of perceived behavioral control and self-efficacy, more narrowly defined. It also addresses dimensions of these constructs that were identified as salient through the studies reviewed. From an overall perspective, self-efficacy (broadly defined) appears to have a positive, independent association with physical activity. Of the 24 studies that offer an assessment of the independence of the relationship, three (12.5%) reported no association at all, four (16.7%) reported a bivariate, but not independent association, eight (33.3%) reported an independent association with no test for mediation by behavioral intention, and nine (37.5%) reported an independent association when the model tested included behavioral intention.

On balance, there appears to be little difference in the impact of the construct chosen to represent self-efficacy – perceived behavioral control or self-efficacy. Considering three definitive categories of results – no bivariate association and both positive and no independent association when testing models that include behavioral intention – one finds both constructs to be relatively evenly represented. Because general constructs are typically reported, it is not possible to offer a differential analysis in terms of dimensions such as “task self-efficacy.” Finally, self-efficacy appears to be associated with physical activity across a wide variety of populations.

Findings: Self-efficacy and intention to participate in physical activity

The relationship between either self-efficacy or perceived behavioral control and intention to participate in physical activity is supported by virtually all studies that explore the relationship. In this author's review of 13 studies since 1995 (including two prior to 1999), all studies found an independent relationship between self-efficacy and intention to participate in physical activity. This includes studies in which intention was conceptualized as intention only (Guinn, Vincent, Jorgensen, Dugas, & Semper, 2007; Smith and Biddle (1999), Okun et al., 2002 & Okun et al., 2003; Lowe et al., 2002; and du Charne & Brawley, 1995), as expectation (Courneya et al., 2000) and three studies that employed measures with both intention and expectation components - Norman and associates (2000), Jackson and associates (2003), and French and associates (2005). Three studies employed one or more Social Cognitive Theory constructs. Courneya and McAuley (1995) and Plotnikoff (2008) studied goals, while Rovniak and associates (2002) studied goals and planning (Rovniak et al., 2002). Most relationships were associated with p-values of less than .001, suggesting highly stable estimates of the relationship. The results of the above mentioned studies are summarized in Table 2.8.

Table 2.8 Studies evaluating the association between self-efficacy and behavioral intention.

Reference	Construct	Sample	Dependent Construct	Finding
du Charme (1995)	S-E ¹	Canadian Adult Females	Intention	B=.13-.16 (p < .02)
Courneya (1995)	PBC ²	Exercise Class Participants	Goals	B=.32 (p not reported)
Smith (1999)	PBC	Health Club Members	Intention	B=.49 (p not reported)
Courneya (2000)	PBC	Canadian Adults	Expectation	B=.17 (p < .001)
Norman (2000)	PBC	Patients at UK Health Promotion Clinics	Intention and Expectation	B=.71 (p < .001)
Rovniak (2002)	S-E	US College Students	Goals and Planning	B=.82 (p < .001)
Okun (2002)	PBC	US College Students	Intention	B=.29 (p < .001)
Lowe (2002)	PBC	UK Adults	Intention	B=.32 (p < .001)
Jackson (2003)	S-E	UK College Employees	Intention and Expectation	B=.34 (p < .001)
Okun (2003)	PBC	US College Students	Intention	B=.26 (p < .001)
French (2005)	PBC	UK Adults	Intention and Expectation	B=.27 (p < .001)
Guinn (2007)	PBC	Low Income Mexican American Women	Intention	B=.33 (p not reported)
Plotnikoff (2008)	S-E	Canadian Diabetics	Goals	B=.59-.62 p < .01 w/Outcome Expectations

1. S-E = Self-efficacy

2. PBC = Perceived behavioral control

Summary of Self-Efficacy with Intention and Physical Activity

Based on present evidence, it is likely that self-efficacy is independently associated with intention to participate in physical activity and physical activity itself.

The literature suggests two potentially interesting caveats:

1. The association between self-efficacy and physical activity may be largely mediated through behavioral intention for physical activity and

2. A direct association between self-efficacy and physical activity may reflect the artificial limitations of the theories that restrict their modeling to intentional or planned behavior, neglecting spontaneous play and vigorous approaches to daily living as activity that *is reported by study subjects*.

In addition to the literature reviewed regarding associations between physical activity and both intention and behavior, self-efficacy is assumed to co-vary with anticipated outcomes, as discussed above. Figure 2.4 represents graphically the reported relationships between self-efficacy and physical activity and the psychological determinants discussed in this study.

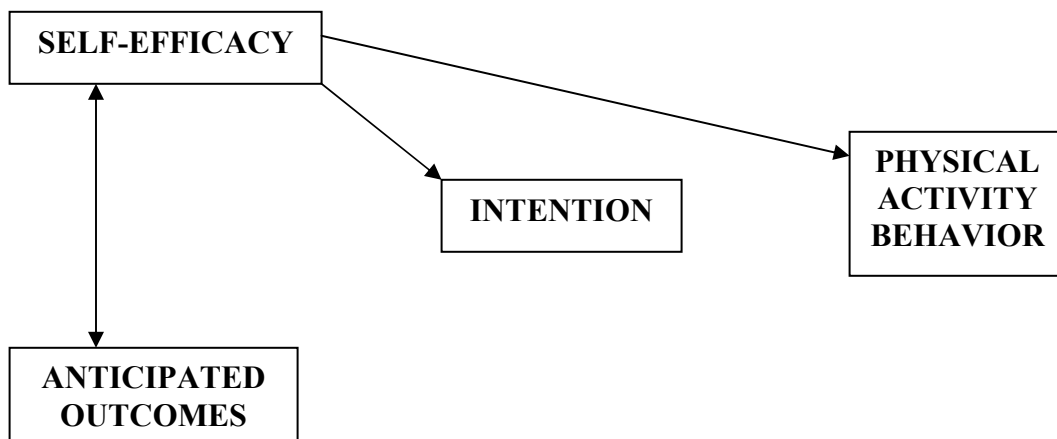


Figure 2.4 Hypothesized associations between self-efficacy and physical activity and the psychological determinants of physical activity.

Anticipated Outcomes for Physical Activity

Theoretical Basis

The concept “anticipated outcomes” for physical activity corresponds to the natural language question “What happens if I participate in physical activity on a regular basis?” Writing for the group of theorists at the NIMH conference on theories of health

behavior, Fishbein (1995, 2002) described the concept in language that included each of three major commonly applied constructs to the concept of attitudes toward a health behavior. He wrote:

The person believes that the advantages (benefits, anticipated positive outcomes) of performing the behavior outweigh the disadvantages (costs, anticipated negative outcomes)-in other words, the person has a positive attitude toward performing the behavior; (1995:250)

Fishbein nodded to Bandura with his reference to anticipated positive and negative outcomes. Bandura put it this way in a more recent writing

...*outcome expectations* about the expected costs and benefits for different health habits,”... “The outcome expectations take several forms. The physical outcomes include the pleasurable and aversive effects of the behavior and the accompanying material losses and benefits. (2004:144)

Last of all, Fishbein acknowledged his own work in this area with his reference to attitudes which he had described in this way at an earlier time:

...a bipolar evaluative judgment of the object. It is essentially a subjective judgment that I like or dislike the object, that it is good or bad, that I’m favorable or unfavorable toward it. Once again, the term “object” is used in a generic sense. (1978:378, as presented in Hill, 1992)

There are at least three general, distinct concepts in these definitions – the likely consequences of an outcome, the values of those consequences, and the existence of barriers to the outcome. Barriers are implicit in both the analysis of self-efficacy and anticipated outcomes. In this study, barriers to physical activity will be dealt with only at the level of these psychological factors.

When pros (or benefits) are considered in combination with cons (or barriers) they yield a construct called “decisional balance.” This construct derives from the work of

Janis and Mann (1977) who developed the notion of a decisional balance worksheet for representing the factors involved in a cost-benefit analysis. While the discrete modeling of pros and cons is common in the literature, the reporting of a single decisional balance variable is not.

A common distinction between types of outcomes deals with instrumental value as opposed to those which are affective in their impact. In the case of physical activity, instrumental outcomes (such as protective effects against coronary heart disease) are likely to be less immediate than affective outcomes, such as enjoyment of the activity.

Findings: Anticipated outcomes and physical activity

Three review articles are addressed first. Trost and colleagues (2002) reviewed the evidence reported between 1998 and 2000 regarding factors related to physical activity, including findings concerning constructs assessing anticipated outcomes of attitudes toward, expected benefits of, value of outcomes for, and barriers to physical activity. They note that research on attitudes has shown consistent evidence of no association, unlike “expected benefits,” which has consistently been found to be associated with physical activity. They note that the “value of exercise outcomes” has shown weak or mixed evidence of no association. While their far-ranging review cited a large number of papers, they failed to provide a coherent, nuanced review of the factors described above, opting instead for generalizations presented in a table.

Marshall and Biddle (2001) produced a meta-analysis of applications of the Transtheoretical Model to physical activity and exercise behavior. They reviewed 71 papers published between 1983 and 2000. They found that perceived pros were

associated with all stage transitions except movement between contemplation and preparation. They found that the strongest association existed for the pre-contemplation to contemplation transition. The authors also reported that cons were significantly associated with all stage transitions. They observed that these associations were small to moderate in magnitude and negative in direction. They reported that movement from the Pre-contemplation to the Action stage was associated with a change of 1.3 standard deviations in perceived benefits and a change of 1.2 standard deviations in perceived disadvantages to physical activity. This contradicts the notion of “Strong and Weak Principles” proposed by Prochaska and associates (1994) who had argued that an increase of 1 standard deviation in pros and .5 standard deviations in cons would be associated with such a change.

Williams and colleagues (2005) reviewed empirical results from studies employing the outcome expectancy concepts. They reported evidence of an “age-dependent association between positive outcome expectancy and physical activity behavior. Specifically, they found that positive outcome expectancy was more predictive of physical activity in older than in young and middle aged adults. They also reported a positive association between outcome expectancy and intention.

Seven studies found no association between a measure of anticipated outcomes and physical activity. Brassington and colleagues (2002) found that neither psychological nor fitness outcome expectancies were associated with exercise adherence in elderly adults. In their evaluation of breast cancer survivors in a multicomponent program for osteoporosis prevention, Ott and associates (2004) found no association

between pros, cons, or decisional balance with physical activity, despite significant increases in mean pros and decisional balance between pre and post intervention assessments.

Booth and colleagues (2000) assessed the influences of negative anticipated outcomes on the physical activity behavior of elderly Australians. They found that perceived risk of injury, enjoyment of physical activity, and time constraints were not associated with energy expenditure from physical activity.

Plotnikoff and colleagues (2008) reported on the relationships among Social Cognitive Theory constructs and physical activity in Type I and Type II diabetics. While they do not provide p-values for their correlations they did construct a structural equation model with no path between “impediments” to physical activity and physical activity itself. On the basis of this evidence, it is inferred that no correlation existed.

Three studies employed Theory of Planned Behavior constructs. Smith and Biddle (1999) reported no correlation between attitude and reports of leisure time exercise. Courneya and McAuley (1995) found no association between attitude and exercise class attendance. Jackson and colleagues (2003) also found no correlation between attitude toward physical activity and physical activity.

A large number of studies reported associations between constructs representing anticipated outcomes and measures of physical activity. These are sorted into two groups, those which tested for independent association and those which did not. This section begins with the latter set of studies.

Five studies reported bivariate associations between anticipated outcomes and physical activity, but did not report the results of multivariate analyses. Sarkin and colleagues (2001) applied the Transtheoretical Model to a study of physical activity behavior in 670 US adults. Their analysis of variance found that pros ($p < .001$) and cons ($p < .001$) were associated with stages of change for physical activity.

Fahrenwald and associates (2003) studied 30 mothers participating in the WIC program. They found that pros were positively associated with stage of change ($\rho = .56$, $p < .01$) and that cons were negatively associated with stage of change $\rho = -.52$, $p < .05$). In their study of Korean adults, Kim and associates (2006) found that the pros and cons for physical activity varied by stage of change for physical activity with p-values less than .001. Though small, the largest differences between mean values for pros were found between the Preparation (3.28) and Action Stages (3.48) and Action and Maintenance stages (3.69). While also small, the largest difference between stage means for cons was found between Pre-contemplation (2.55) and Contemplation (2.28).

Plotnikoff and colleagues (2001) presented a research report employing the Transtheoretical Model in the prediction of physical activity behavior in Canadian adults. The report noted that pros were associated with transitions from pre-contemplation to contemplation ($p = .005$); contemplation to preparation ($p = .001$); and retention in either the action or maintenance stage ($p < .005$). They also found that cons were associated with the transition from the preparation stage to the action stage ($p < .05$) and retention in either the action or maintenance stages ($p < .001$).

Rogers and associates (2005) studied the association of social cognitive factors with physical activity in breast cancer survivors. They reported bivariate correlations between enjoyment and energy expenditure ($r=.60$, $p<.02$) and a negative outcome expectations value score and energy expenditure ($r= -.60$, $p < .02$). The bulk of these studies employ the stages of behavioral change approach to analysis. Models developed from this perspective are more readily tested for bivariate relations than multivariate analysis, although logistic regressions can be computed for both specific stage transitions and a general evaluation of positive or negative change. The reasons behind the lack of multivariate assessments in these studies are not known.

Seven studies reported no significant relationship between one or more constructs of anticipated outcomes and physical activity when analyses included constructs of self-efficacy and/or behavioral intention. This was true for analyses that employed either measures of attitudes (four in all) or outcome expectations (three in all). One other study included in this section reported a positive bivariate association that was not replicated when a regression model absent self-efficacy and intention was estimated.

Research employing the Theory of Planned Behavior commonly tests for independence of relationship between psychological constructs and physical activity. Okun and associates report two studies (2002; 2003) with similar results. Both of these reports are based on research employing samples from university populations and both find that attitudes toward physical activity are correlated, but not independently associated with leisure time exercise. Both analyses included perceived behavioral control and behavioral intention in regression models.

Two studies employed differentiated measures of attitude – instrumental and affective. Karvinen and associates (2007) studied endometrial cancer survivors and found that both instrumental and affective attitudes were correlated with physical activity, but not independently associated when analyzed with a multiple regression analysis that included perceived behavioral control and behavioral intention as predictors. Lowe, Eves, and Carroll (2002) studied adults in Britain and found a similar pattern of relationship (correlation, but not independence) between instrumental attitude and physical activity.

Two studies employed social cognitive constructs in structural equation models predicting physical activity. Rovniak and colleagues (2002) studied American university students and found that while both positive and negative outcome expectations and enjoyment had significant bivariate associations with each of three measures of physical activity, the latent factor outcome expectations which combined all three of the above constructs was not significantly associated with the latent factor physical activity. Similarly, Plotnikoff and associates (2008) studied a sample of diabetic adults from Canada similarly. They found that while the latent factor positive outcome expectations was correlated with the number of minutes per week of strenuous and moderate physical activity, the association was not independent when tested in a structural equation model.

Cardinal and colleagues employed the Transtheoretical Model in a study of physical activity in Finnish and American college students (2003). Their regression analysis that included self-efficacy revealed a lack of independent association between both pros and cons, on one hand, and stages of change for physical activity, on the other. Finally, Booth and associates (2000) reported from their study of elderly Australian

adults that while perceived health benefits were correlated with energy expenditure from exercise, the relationship was not found to be independent, even when other psychological factors such as self-efficacy and behavioral intention were omitted from the model.

Three studies found an independent association between a construct of anticipated outcomes and a construct of physical activity, when no constructs representing either self-efficacy or behavioral intention were included in the model. Pinto and colleagues (2001) studied the impact of a physician based counseling intervention on adults age 50 and over. They reported that a change in decisional balance was associated with the transition from the Preparation to the Action stage ($OR=1.58$, $p < .0065$) for physical activity. Lian and colleagues (1999) studied the correlates of leisure time physical activity in elderly Singaporean adults. They found associations between barriers ($b=-.54$, $p < .001$) and knowledge of benefits ($b=.05$, $p < .05$) with frequency of exercise for males and females. Leslie and associates' study of Australian college students (1999) found that low levels of enjoyment were associated with classification as insufficiently active in terms of the frequency and duration of their recreational and travel physical activity ($OR=1.25$, $CI = 1.05-1.49$, $p = .01$).

Bourdeaudhuij and Sallis (2001) found gender and age differences in the associations between perceived benefits and barriers, on one hand and energy expenditure through physical activity, on the other, when models also accounted for self-efficacy. Three patterns of independent association were found among young adults. Competitive benefits ($b=.14$, $p < .05$) and lack of interest ($b= -.12$, $p < .05$) were found to be

independently associated with exercise energy expenditure in males as was health benefits for females ($b=.13$, $p < .05$). Only one pattern of independent association was identified among 35-45 year old respondents. The factor body image and health benefits was associated with exercise energy expenditure for males only ($b= .20$, $p < .01$). Older respondents were found to have three patterns of association. Psychological or health barriers was associated with exercise energy expenditure for both males ($b= -.17$, $p < .05$) and females ($b= -.28$, $p < .001$). Additionally, body image and health benefits was associated with energy expenditure for females ($b= .14$, $p < .05$).

From a theoretical perspective, the strongest evidence of an independent association between anticipated outcomes and physical activity requires multivariate analysis that includes both behavioral intention and self-efficacy for physical activity among covariates. Two studies provided this level of evidence. Lowe's study of the influence of beliefs on exercise intentions and behavior (2002) found that affective beliefs were positively and independently associated with energy expenditure from exercise ($b=.13$, $p < .05$), even when perceived behavioral control and behavioral intention were included in multiple regression analysis. Courneya and associates (2000) found a small, but significant, independent association between attitude and leisure time exercise ($b=.07$, $p < .001$) while employing a hierarchical regression model that included behavioral intention, perceived behavioral control, and social support. Table 2.9 provides a summary of findings addressed in this section.

Table 2.9 Studies evaluating the association between anticipated outcomes and physical activity.

Reference	Construct	Sample	Dependent Construct	Finding
Brassington (2002)	Outcome Expectancies	US Older Adults	Exercise Adherence	No Correlation
Ott (2004)	Decisional Balance	Breast Cancer Survivors	Strength Training Adherence	No Association
Plotnikoff (2008)	Impediments	Canadian Diabetics	Leisure Time Exercise	No Association
Booth (2000)	Enjoyment	Older Australian Adults	Active	No Association
Smith (1999)	Attitudes	Health Club Members	Leisure Time Exercise	No Association
Courneya (1995)	Attitudes	Exercise Class Participants	Exercise Class Attendance	No Association
Jackson (2003)	Attitudes	UK College Students	Leisure Time Exercise	No Association
Plotnikoff (2001)	Cons	Canadian Adults	Stage of Change for Physical Activity	No Association
Sarkin (2001)	Cons	US Adults	Stage of Change for Physical Activity	t score sig p < .001
Sarkin (2001)	Pros	US Adults	Stage of Change for Physical Activity	t score sig p < .001
Plotnikoff (2001)	Pros	Canadian Adults	Stage of Change for Physical Activity	t=2.63 p = .005
Fahrenwald (2003)	Pros	WIC Program Participants	Stage of Change for Physical Activity	Rho = .56 p < .01
Kim (2006)	Cons	Korean Adults	Exercise Stage of Change	r=.06 p < .05
Kim (2006)	Pros	Korean Adults	Exercise Stage of Change	r=.21 p < .01
Rogers (2005)	1. Barriers 2. Enjoyment	US Women in Breast Cancer Therapy	Total Physical Activity	1. rho= - .51 2. rho= .60
Okun (2002)	Attitudes	US College Students	Leisure Time Exercise	r=.52 p < .001 NS w/Intention & PBC
Okun (2003)	Attitude	US College Students	Leisure Time Exercise	r=.35 p < .001 NS w/intention and S-E
Rogers (2005)	1. Barriers 2. Enjoyment	US Women in Breast Cancer Therapy	Total Physical Activity	1. rho= - .51 2. rho= .60
Karvinen (2007)	Attitude	Endometrial Cancer Survivors	Leisure Time Exercise	r Not Reported NS w/Intention and S-E

Table 2.9 continued Studies evaluating the association between anticipated outcomes and physical activity.

Reference	Construct	Sample	Dependent Construct	Finding
Okun (2002)	Attitudes	US College Students	Leisure Time Exercise	$r=.52$ $p < .001$ NS w/Intention & PBC
Lowe (2002)	Instrumental Attitude	UK Adults	Leisure Time Exercise	$r=.16$ $p < .01$ NS w/Attitude and S-E
Lowe (2002)	Instrumental Attitude	UK Adults	Leisure Time Exercise	$r=.16$ $p < .01$ NS w/Attitude and S-E
Rovniak (2002)	Outcome Expectations (+ & -)	US College Students	Stage of Change Energy Expend. # Activity Modes	All Measured Variables Correlated; All NS w/Self-Regulation & S-E
Plotnikoff (2008)	Outcome Expectations (+ & -)	Canadian Diabetics	Leisure Time Exercise	$r=.22/.18$ NS w/Goals
Cardinal (2004)	Pros, Cons, & Barriers	US Adults with Disabilities	Stage of Change for Exercise	Associated with all Stages
Booth (2000)	Benefits	Older Australian Adults	Active	χ^2 $p = .01$
Pinto (2001)	Decisional Balance	Sedentary US Adults	Occupational and Leisure Time Physical Activity	NS w/Behavioral Processes & S-E
Lian (1999)	Benefits & Barriers	Older Singaporean Adults	Leisure Time Physical Activity	$b = -.53$ to $-.54$ $p < .001$ w/DN
Leslie (1999)	Enjoyment	Australian College Students	Sufficient Physical Activity	OR=1.25 (1.05-.149) for Males OR=1.18 (1.04-1.35) for Females
Bourdeaudhuij (2002)	Benefits & Barriers	Belgian Adults	Leisure Time exercise	Various Dimensions Vary by Age and Gender
Bourdeaudhuij (2002)	Benefits & Barriers	Belgian Adults	Leisure Time Exercise	Dimensions Vary by Age and Gender
Lowe (2002)	Affective Beliefs	UK Adults	Leisure Time Exercise	$b=.13$ $p < .05$ w/Intention & S-E
Courneya (2000)	Attitudes	Canadian Adults	Stage of Change for Physical Activity	$b=.07$ $p < .01$ w/Intention & S-E
McAuley (2007)	Affect	Older US Adults	Physical activity scale for elderly	$B=.14$ $p < .05$ w/previous behavior and S-E

1. S-E = Self-efficacy

2. DN = Descriptive Norm

Summary: Anticipated outcomes and physical activity

The balance of the findings from research on the relationship between various constructs representing anticipated outcomes and physical activity is one sided. Only two studies report independent associations between these two variables when behavioral intention and self-efficacy are included as covariates in multivariate analyses. On the other hand, seven studies reported no bivariate association and eight studies reported correlations, but no independent associations between the variables.

Interestingly, these two outlier studies might point to boundary conditions. One study, (Lowe, 2002), points to the possibility that affective attitudes might be more strongly associated with physical activity than other types of attitude or expectations. This finding, however, is contradicted by Karvinen (2007) and merits further investigation. No other specific construct (as opposed to a general measure) representing positive or negative outcome expectations appears to be independently associated with physical activity.

On the other hand, the possibility that direct association exists between anticipated outcomes and a specific measure of physical activity (one or more specific stages of change) is certainly reasonable. Courneya and colleagues (2000) found that attitude was associated with stage of change for physical activity, but Cardinal (2003) did not find this relationship. As noted earlier, five studies found a bivariate association between anticipated outcomes and stages of change for physical activity. Some of these reported differing results by stage, as predicted by Prochaska (1994) who argued that changes in pros and cons were required to move from pre-contemplation to

contemplation and beyond. Unfortunately, these studies did not test for mediation by either intention and/or self-efficacy. This leaves the issue of a bounded, direct association between anticipated outcomes and physical activity unresolved. For purposes of this study, no independent association will be included in models because they do not employ a measure of stages of change that could capitalize on the relationship between anticipated outcomes and both intention and physical activity behavior.

Findings: Anticipated outcomes and intention to participate in physical activity

The bulk of the evidence reviewed points toward an independent association between anticipated outcomes and behavioral intention. No studies reported a complete absence of association. There were three contrary findings, all of which involved analyses that included attitude and perceived behavioral control constructs. Norman (2000) found that attitudes were not independently associated with behavioral intention when employing a regression model that included perceived behavioral control. French (2005) found no independent association when employing a model that included instrumental attitude and perceived behavioral control. In their study of American college students, Rovniak and colleagues (2002) found that, while the individual factors composing outcome expectations were correlated with those composing goals and plans, the latent factors were not independently associated in a structural equation model.

Ten studies reported independent associations between one or more construct representing anticipated outcomes and behavioral intention when the relationship was analyzed with models including a construct representing self-efficacy. The bulk of these studies are based on evaluations of the Theory of Planned Behavior and, therefore,

employ attitude constructs in their models. These include Courneya's 2000 study of Canadian adults ($b=.36, p < .001$); Okun's 2002 and 2003 studies of college students ($b=.34, p < .001$ and $b=.46, p < .001$, respectively); Smith and Biddle's 1999 path analytic study of British health club members ($b=.31$), and Courneya's 1995 path analytic study of exercise class participants ($b=.31$). Three studies employed models that included self-efficacy and outcome expectations, both finding independent associations. Karvinen (2007) studied cancer survivors ($b=.30, p < .001$) and Jackson (2003) studied adult employees of a university in the UK and found a similar pattern of relationship ($b=.30, p = .001$). Plotnikoff and associates (2008) employed structural equation modeling and found that positive outcome expectations were associated with physical activity goals for both Type I ($b=.21$) and Type II ($b=.20$) diabetics. They also found that impediments were negatively associated with goals for Type II ($b= -.08$) diabetics only.

Two studies provide more revealing results in their analysis of the anticipated outcomes – behavioral intention relationship. French (2005) reported an independent association between *affective* attitude and intention to increase physical activity ($b=.39, p < .001$) with a measure of perceived behavioral control included in the model. Lowe (2002) reported a similar relationship ($b=.36, p < .001$) based on a model that included perceived behavioral control.

Summary: Anticipated outcomes and intention to participate in physical activity

Evidence suggests that a direct association between anticipated outcomes and behavior intention exists. Given the assumed association between self-efficacy and anticipated outcomes, partial mediation of the anticipated outcomes – behavioral

intention should be expected and is suggested by the three negative findings reviewed here.

Table 2.10 Studies evaluating the association between anticipated outcomes and intention to participate in physical activity.

Reference	Construct	Sample	Dependent Construct	Finding
Rovniak (2002)	Outcome Expectations	US College Students	Goals and Planning	All Measured Variables correlated; All NS w/S-E ¹
French (2005)	Instrumental Attitude	UK Adults	Intention and Expectation	NS w/S-E
Plotnikoff (2008)	Impediments	Canadian Diabetics	Goals	b=.05/.09 p < .01 for Type II Only w/S-E
Lowe (2002)	Instrumental Attitude	UK Adults	Intention	r=.34 p < .001 NS w/S-E
Norman (2000)	Attitude	UK Patients at Health Promotion Clinics	Intention and Expectation	.33 p < .01 NS w/S-E
Karvinen (2005)	Instrumental Attitude	Endometrial Cancer Survivors (only healthy weight)	Intention	b=.61 w/S-E
Plotnikoff (2008)	Positive Outcome Expectations	Canadian Diabetics	Goals	b=.21/.20 p < .01 w/S-E
Courneya (1995)	Attitude	Exercise Class Participants	Intention	b=.31 w/S-E
Okun (2002)	Attitude	US college students	Intention	b=.34 p < .001 w/S-E
Okun (2003)	Attitude	US college students	Intention	b=.46 p < .001 w/S-E
Courneya (2000)	Attitude	Canadian Adults	Expectation	b=.36 p < .001 w/S-E
French (2005) ^a	Affective Attitude	UK Adults	Intention and Expectation	b=.39 p < .001 w/S-E
Smith (1999)	Attitude	Health Club Members	Intention	b=.31 w/S-E
Jackson (2003)	Attitude	UK College Employees	Intention and Expectation	b=.30 p < .001 w/S-E
Lowe (2002)	Affective Attitude	UK Adults	Intention	b=.36 p < .001 w/S-E

1. S-E = Self-efficacy

Summary of Anticipated Outcomes with Intention and Physical Activity

The literature reviewed here suggests that anticipated outcomes for physical activity are independently and positively associated with intention to participate in physical activity, but not with physical activity itself. These findings are depicted graphically in Figure 2.5 below.

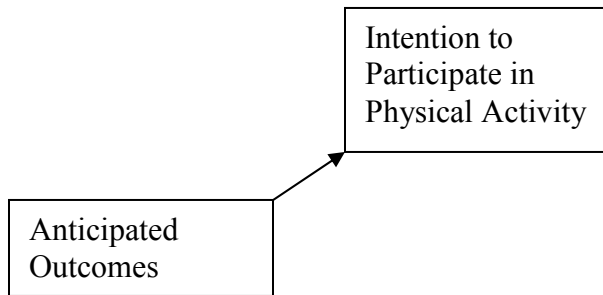


Figure 2.5 Hypothesized associations between anticipated outcomes and physical activity and the psychological determinants of physical activity

Summary of Findings Regarding Psychological Factors and Physical Activity

Intention to participate in physical activity appears to be independently associated with physical activity behavior. Self-efficacy for physical activity also appears to be independently associated with physical activity behavior and with behavioral intention. Anticipated outcomes appears to be independently associated with behavioral intention, but not with physical activity behavior. For purposes of this study, anticipated outcomes and self-efficacy are understood to co-vary, with no attempt made to assign causal sequence. Figure 2.6 summarizes these findings in graphical form.

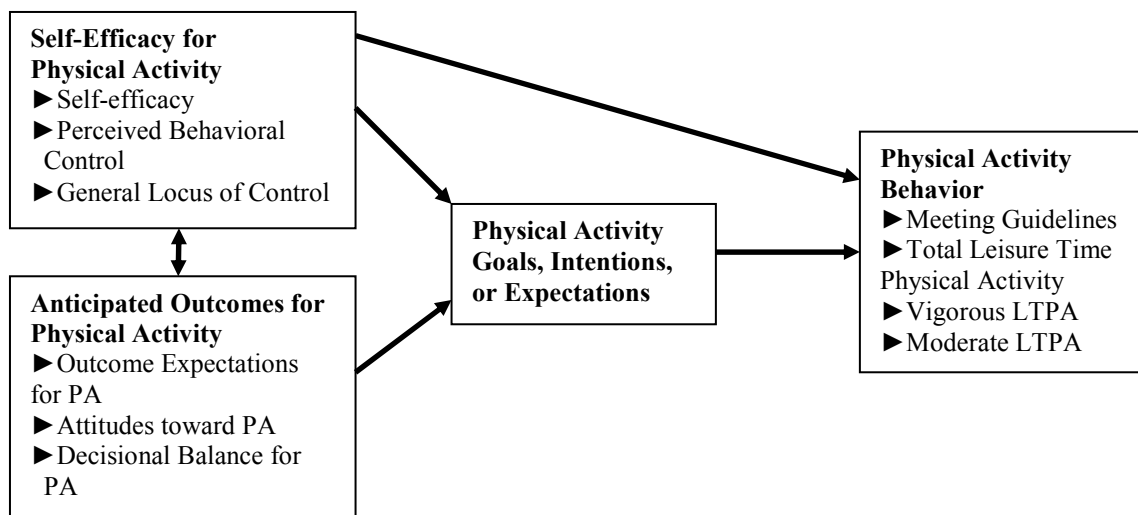


Figure 2.6 Hypothesized associations among psychological factors and physical activity as reported in the literature.

Associations Between Physical Activity And Interpersonal Factors

The third set of factors to be reviewed includes those which constitute interpersonal influences on physical activity behavior. The literature refers to these as social support and the subjective, descriptive norm. These factors derive both from direct interaction with and observation of others. Subjective, descriptive norms are a person's perceptions of what is common behavior within a given segment of his/her social environment. These perceptions are constructed from the observations of and interactions with others. As such, they constitute an indicator of social influence owing to a broad construction of the social environment. Social support for physical activity derives from exchange relationships in which actors receive resources that facilitate their participation in physical activity. This more narrowly defined source of social influence is assumed to be both related to and discriminable from the descriptive norm.

The goal of this literature review is to assess the existence of independent associations between these two potential sources of social influence and psychological mediators of physical activity and, as well as with physical activity, itself. The pathways represented by dotted lines in Figure 2.7 represent the relationships that will be evaluated in this review. The solid lines represent independent relationships for which evidence was at least equivocal in the foregoing review of psychological mediators, as well as the assumed relationship between social norms and social support.

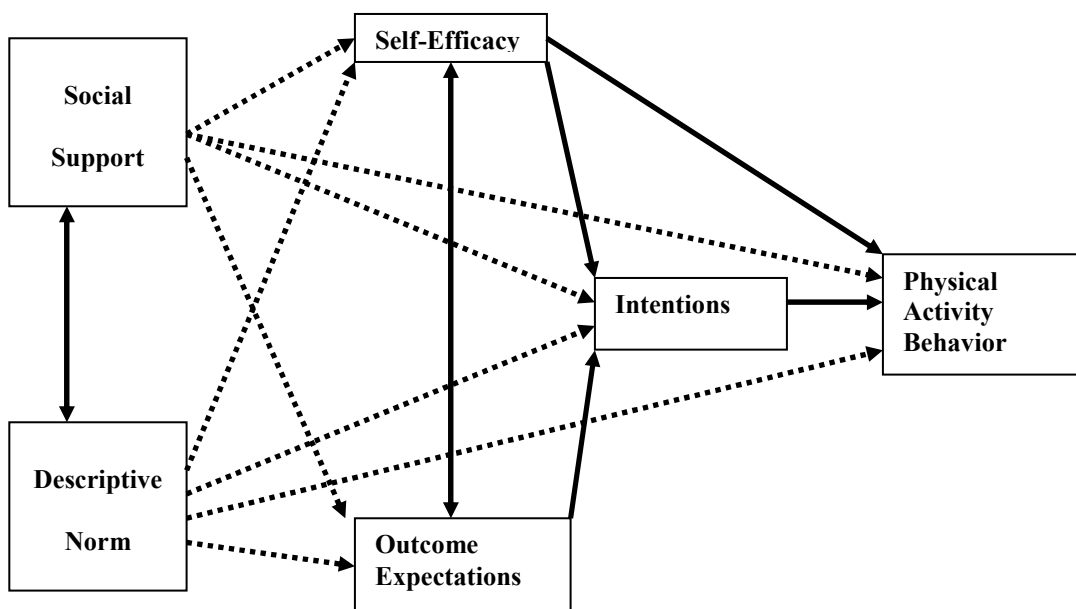


Figure 2.7 Hypothesized associations among interpersonal factors, psychological factors, and physical activity covered in this review.

Descriptive Norm for Participation in Physical Activity

Theoretical Basis

Cialdini and Trost (1998:155) argue that descriptive norms “...are derived from what other people do in a given situation.” They note that this helps people understand what is “normal” behavior especially in novel or ambiguous situations. People do this because it facilitates our “perceiving and dealing with our environment.” Citing Festinger’s work on social comparison processes (1954), they note that people are more likely to engage in use of the descriptive norm to inform their actions when the people who are being observed are *similar to the observer*. Descriptive norms are also found to be more influential on people’s behavior when the observer has been *primed to be aware of a norm*, either through the presentation of *behavior that is consistent* with the norm

and to an even greater degree when *behavior is observed that is inconsistent* with the norm in question (Cialdini, Reno, & Kallgren, 1990).

Normative behavior is not limited to action. Heise (2006:13) notes, “Your public acts and comments influence others and shape their social acts.” In this view, both words and deeds are part of normative behavior and can influence others’ words and deeds.

The Theory of Planned Behavior (Ajzen, 1991) originally posited that the injunctive aspect of the subjective norm - which is understandable as what a person thinks others who are close to him think he/she should or should not do (Cialdini and Trost, 1998) – would be a predictor of behavioral intention. Research on physical activity has shown that this prediction is only weakly supported at best (Trost et al., 2002) and commonly rejected (Okun et al., 2002). Perhaps because physical activity is viewed as a behavior with positive social connotations, the injunctive aspect of the norm is not as salient as it might be for behaviors associated with negative health outcomes and/or social sanctions (Okun et al., 2003). Recently, Ajzen (2002) has recommended including the descriptive norm in studies of physical activity. He has also recommended an approach for measurement that mirrors that used in assessment of the injunctive norm.

Generally speaking, there is both theoretical and empirical evidence suggesting an association between the descriptive norm and behavior. As to whether this association exists in the specific case of physical activity and in what ways this association is mediated by psychological variables and moderated by other factors will be evaluated using the scant existing evidence reviewed below.

Findings: Descriptive norm and physical activity

Six studies present results describing the relationship between the descriptive norm and physical activity. Two of these are literature reviews and the rest are reports on single studies.

Two literature reviews address the relationship between the descriptive norm and physical activity. Trost and colleagues (2002) found weak or mixed evidence of a positive association between “frequent observation of others engaging in physical activity” and participation in physical activity. Wendel-Vos and colleagues (2007) found no association between “seeing others exercise” and “exercise” in their review of potential environmental determinants of adult physical activity.

Two reports mentioned in the Trost review are those of Booth (2000) and King (2000). Booth and associates (2000) found that the frequent observation of others being active was not associated with physical activity ($p < .08$). On the other hand, King and associates (2000) assessed the descriptive norm as “frequently see others walking.” Their logistic regression analysis found that positive responses to this item were associated with a greater likelihood of classification as underactive or active versus sedentary ($OR=1.26$ (1.06-1.50) $p < .01$). Considering the findings of Wendel-Vos (2007), Booth (2000) and King (2000), it appears that there may be a modest, at most, relationship between the frequent observations of non-significant others engaged in physical activity and participation in physical activity.

The evidence regarding the normative influence of significant others is also scant and mixed. Jackson and colleagues (2003) found that the physical activity behavior of

“most people I know” was not associated with leisure time exercise. Ravis and Sheeran (2003) found that while it was correlated with physical activity, when perceptions of friends’ behavior were included in a model that also contained intention, perceived behavioral control, and attitudes, there was no independent association. On the other hand, Booth and associates (2000) measured social modeling as “Partner active one time or more/week and friends/family active.” They found that partner activity was positively associated with physical activity - versus inactivity ($p < .01$). The activity levels of friends and family activity were associated with respondent’s physical activity - versus inactivity ($p < .001$).

Okun and associates tested the relationship between the descriptive norm and physical activity in regression models that included perceived behavioral control, attitude, and intention. Okun and colleagues (2002) reported on the relative impact of the injunctive and descriptive norms, the latter being measured in terms of the behavior of family and friends. Their regression analyses found that the descriptive norm was associated with leisure time exercise ($b=.19$; $p < .001$). In 2003 Okun and associates tested the relative impact of social support and the descriptive norm through a series of regression models. They found that the descriptive norm, measured in terms of the behavior of friends, was independently associated only with strenuous exercise ($b=.14$; $p < .01$) in a model that included social support. Only the studies of Okun and associates have reported independent associations between the descriptive norm and physical activity, when testing models that included social support, self-efficacy, anticipated outcomes, and intention. This finding applied only to strenuous exercise and was found to

be true in a sample of US college students referencing the behavior of family and/or friends.

Taken collectively, these results suggest that what a person perceives as normative physical activity behavior may be associated with their level of physical activity, even when the impact of social support is considered. The robustness of this finding is unclear; there is hardly sufficient evidence to determine whether or not this association is independent of other social and psychological factors and precisely how it might be bounded. There is a need for more research on this question.

Findings: Descriptive norm and intention to participate in physical activity

Only four studies report evaluation of a relationship between the descriptive norm and intention to participate in physical activity. Ravis and Sheeran (2003a) found that the descriptive norm, assessed in terms of people known to the college student respondents, was independently associated with behavioral intention ($b=.13$, $p < .001$). Okun and associates (2002) tested this relationship in a series of regression analyses and found that the friend (but not family) descriptive norm was independently associated with intention ($b=.09$; $p < .05$) in a model that included perceived behavioral control, attitude, and injunctive norm. However, Okun and associates (2003) found that the association between the descriptive norm and intention to participate in physical activity was completely accounted for by the independent association between perceived behavioral control and intention. More recently, Karvinen and colleagues found that the behavior of significant others was weakly associated ($b=.10$, $p < .04$) with cancer patients' intention to be active when attitudes and perceived behavioral control were included in the

analysis. Given the sample limitations on these studies (all three were drawn from US college students), these findings are at best suggestive and offer few clues to potential boundary conditions.

Findings: Descriptive norm and self-efficacy for physical activity

Little evidence exists as to the relationship between the descriptive norm and self-efficacy for physical activity. Okun and associates found correlations between the descriptive norm and perceived behavioral control for leisure time exercise in two studies (2002 and 2003). In the 2003 study, Okun and associates found an independent association between descriptive norm and perceived behavioral control for exercise ($b=.16$, $p < .01$) in a regression model that included social support, attitude, and injunctive norm. This relationship is in need of further evaluation.

Findings: Descriptive norm and anticipated outcomes for physical activity

A similar dearth of research exists regarding the relationship between descriptive norm and anticipated outcomes for physical activity. While Okun and associates found correlations between the descriptive norm and attitudes toward leisure time exercise in two studies (2002 and 2003), their 2003 study did not find an independent association between the two when social support, attitude, and injunctive norm were included in a regression model. This finding suggests that the association may be mediated entirely through perceived behavioral control, which was found to have an independent association with attitudes.

Summary of Descriptive Norm with Physical Activity, Intention, Self-Efficacy, and Anticipated Outcomes

Little research has been done regarding the relationships between the descriptive norm for physical activity, on one hand, and social support, psychological mediators, and physical activity, on the other. The limited evidence that does exist can be used to form testable hypotheses. It appears unlikely that an independent association exists between the descriptive norm and physical activity except, perhaps, for strenuous physical activity. It may be that the descriptive norm – physical activity relationship that does exist is mediated through self-efficacy.

In the absence of a large body of research on the association between the descriptive norm for physical activity and participation in regular exercise, it is worth considering the Ravis and Sheeran (2003b) study of the use of the descriptive norm in Theory of Planned Behavior research on health behaviors. While none of the studies considered dealt with physical activity, they did consider some health promoting behaviors such as healthy eating and condom use. They found that the descriptive norm had sample size weighted correlations with behavioral intention ($r=.46$), attitude ($r=.38$), and perceived behavioral control ($.08$). Employing these coefficients as data for regression analysis, they found an independent association between descriptive norm and intention ($b=.24$, $p < .001$).

In sum, it is clear that the descriptive norm is associated with social support, self-efficacy, anticipated outcomes, intention, and physical activity behavior. It is not clear whether these relationships are mediated by several of these other factors. Accordingly,

the following model (Figure 2.8) proposes testing all associations between the descriptive norm for physical activity and all other study variables.

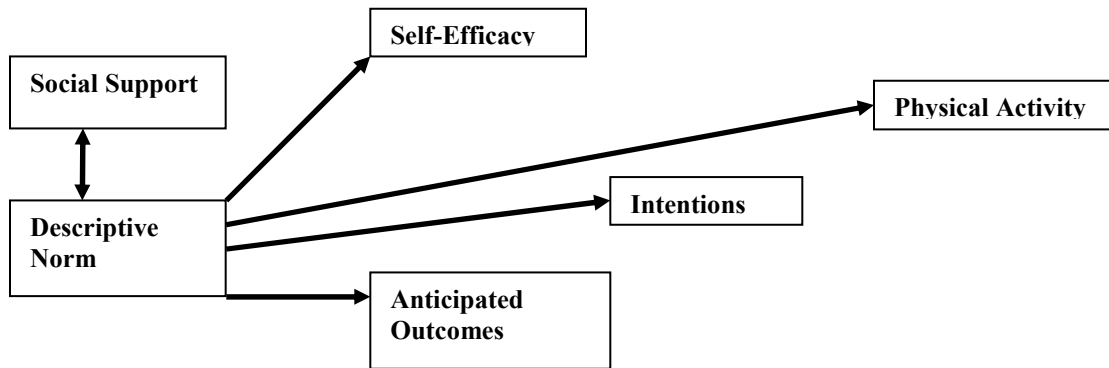


Figure 2.8 Hypothesized associations between descriptive norm and other covariates of physical activity and physical activity.

Social Support for Participation in Physical Activity

Theoretical Basis

House (1981), cited in Heaney and Israel (2002:186), define social support as the “functional content of relationships.” Heaney and Israel note that this content can be categorized as informational, instrumental, emotional, and/or appraisal. According to Israel (1982) and House (1981), the types of social support are defined in Table 2.11 below:

Table 2.11 Forms of social support

Type of Social Support	Definition	Operational Approaches
Emotional Support	Expressions of empathy, love, trust, and caring	Encouragement to participate in physical activity; Sympathizing with actor's comments on the difficulty of physical activity
Instrumental Support	Tangible aid and service	Helping with childcare or chores to enable the actor to participate in physical activity; Serving as a companion for physical activity.
Informational Support	Advice, suggestions, and information	Explaining how to manage regular physical activity; Explaining where to find appropriate clothing for physical activity
Appraisal Support	Information that is useful for self-evaluation	Self-esteem building comments; Positive assessments of the impact of physical activity on the actor.

Adapted from Heaney and Israel (2002).

Social support can also be analyzed in terms of its sources. Commonly, social support is assessed in terms of either familial or friend sources. In rare studies, an occupational category of alter is included, such as the use of fellow students by Okun (2003). Co-workers would be in this same category. Because few studies differentiate their reports of association between sources and types of social support and physical activity, it is necessary to consider reports that are undifferentiated on one or both dimensions. Failure to differentiate by dimensions is sometimes the result of multiple sources and/or types of social support being represented by a single scale that combines differentiated individual items. In other cases, only a general statement that does not distinguish among sources and types of support is used to assess social support.

Findings: Social support and physical activity

Social support has been found to be associated with physical activity and its determinants by a large number of researchers. This review encompasses 24 papers that assessed the existence of an independent association between social support and physical activity. Two of these 24 are reviews and eight of the other 22 papers are addressed in the most recent of these reviews. They are included here to provide more data for a finer grained evaluation of the social support – physical activity relationship than was provided in the review itself. Fourteen other papers are research reports issued since the most recent review.

This review of findings regarding the association between social support and physical activity is composed of three sections – review articles, studies in which no distinctions were made among types of social support, and studies that distinguished among types of social support. It is followed by a review of the relationships between social support and the psychological variables through which its impact on physical activity levels might be mediated.

Reviews

Trost and colleagues' review of correlates of adult participation in physical activity (2002) provides a cryptic analysis of research on the social support – physical activity relationship. They note that social support had been found to be consistently associated with physical activity in research reported between 1998 and 2000 and that this finding is consistent with earlier research; they do not differentiate between correlations and independent associations. Marshall and Biddle's meta-analysis of

applications of the Transtheoretical Model to physical activity behavior is slightly more specific (2001). Although it describes studies with a considerable degree of variation in measurement approaches, it does not distinguish among them. It does, however, describe significant average effect sizes for social support on the transition from pre-contemplation to contemplation (.55) and from preparation to action (.44). It also notes that other stage transitions are not associated with the helping relationships construct used in research based on the Transtheoretical Model.

General social support

Sixteen papers that reported social support as a general concept were reviewed. One report (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002) found no association between either baseline or changes in social support and exercise adherence. All other studies found at least some pattern of association between social support and physical activity. Using one way analysis of variance, Fahrenwald and associates (2002) found that helping relationships were used significantly less often by women in the pre-contemplation stage for regular physical activity than by those in more advanced stages. They reported no multivariate analysis in this study. Similarly, Plotnikoff and colleagues (2001) employed univariate F tests and found that helping relationships were associated with movement from the contemplation to the action/maintenance stage of change for physical activity.

There were four studies that found correlations between social support and physical activity but found no independent association between the constructs in regression analysis. Two of these, Rovniak and associates (2002) and Plotnikoff and

associates (2008), reported correlations between physical activity and social support, but constrained these paths to zero in structural models. Plotnikoff's model had fit statistics of high enough quality (TLI = .99, CFI=.99; and RMSEA = .04) that it is unlikely that a direct path from social support to physical activity would be significant. Rovniak and colleagues' model fits less well (GFI=.96, AGFI = .93, RMSEA=.06), and she did not mention the consideration of modification indices for the structural model, although she did so for the measurement model.

Castro and colleagues (1999) found correlations between social support and walking behavior, but did not find independent associations between social support and walking in regression analyses that included self-efficacy (also non-significant) and other social cognition variables. Calfas and colleagues (1997) found that the construct baseline behavioral processes (which included helping relations) was positively correlated with stage of change for physical activity and that change in behavioral processes was positively correlated with the same stage of change measure as well as with walking behavior. Neither social support variable was correlated with leisure activity or accelerometer scores. No social support measures were found to be independently associated with physical activity in their multiple regression analyses, however.

Three studies reported independent associations between social support and physical activity, but did not include self-efficacy (a likely mediator of the relationship) in their regression models. Eyler (1999) analyzed the association between social support and physical activity in middle aged and older minority women. Using logistic regression she found that high and moderate levels of social support were negatively

associated with reports of sedentary behavior. Those reporting the highest level of social support were more likely to participate in 150 minutes of leisure time physical activity weekly and 300 or more minutes of total physical activity. While this study included sociodemographic factors as covariates in regression analyses, it did not include psychological constructs that could act as mediators of the association between social support and physical activity. Wilcox and associates (2000) found that social support for leisure time physical activity was independently and negatively associated with sedentary lifestyle using a regression model that included barriers to physical activity, but not self-efficacy or outcome expectations. Leslie and colleagues (1999) found that Australian college students who were less likely to have emotional (encouragement) and instrumental (companionship) support were less likely to be classified as having sufficient physical activity levels. Because these types of support were pooled in the analysis, the study is classified as a study of general social support. While the logistic regression analysis did not include self-efficacy, it did include enjoyment of exercise, a potential moderator of the social support – physical activity relationship.

Six studies reported independent associations between social support and physical activity while controlling statistically for the impact of potential psychological mediators of the relationship. Miller, Trost, and Brown (2002) found that changes in partner support were independently associated with the likelihood of women with young children meeting physical activity guidelines (OR=2.29; CI = 1.46-3.58) when self-efficacy was included in the same logistic regression model. Kim (2006) reported that stage of change for physical activity was predicted using a discriminant model including self-efficacy,

outcome expectations, helping relationships and other social cognitive variables.

Sternfield, Ainsworth, and Quesenberry (1999) reported that subjects from a diverse sample of women were more likely ($OR = 2.34$, $CI = 1.83-2.98$) to be classified as “high” for their level of sports and exercise participation if they were rated “high” for their level of social support. This finding was made using a regression model that included self efficacy, lack of motivation, and external obstacles.

Courneya and associates (2000) reported that social support was independently associated with stage of change for exercise behavior ($b=.09$, $p < .001$) in a hierarchical regression model that included intention, perceived behavioral control, and attitude. Finally, Marquez and McAuley (2006) reported that social support from friends was independently associated with level of leisure time physical activity in a study of Latinos. This positive result was obtained with a model that included self-efficacy. Social support from family did not present the same association in the multivariate model. Less convincingly, Cardinal, Tuominen, and Rintala (2003) studied a sample of Finnish and American college students and found that self-efficacy and behavioral processes of change were significant correlates of exercise behavior in a stepwise regression analysis. Included in behavioral processes was the use of helping relationships. This finding is at best suggestive because the various behavioral processes are not assessed individually.

A summary of the evidence regarding an association between general measures of social support and physical activity is presented in Table 2.12 below. The evidence regarding the existence of an independent association between a general measure of social support and physical activity is mixed. Six studies presented evidence of an

independent association with analyses that included one or more potential psychological mediators and five presented either evidence of no association or of a bivariate association and not an independent one. Four studies did not report analyses with potential psychological mediators. On balance, the evidence for an independent association must be judged as inconclusive.

Table 2.12

Studies evaluating the association between general measures of social support and physical activity

Reference	Construct	Sample	Dependent Construct	Finding
Brassington (2002)	General	Older US Adults	Exercise Adherence	No Association
Marquez (2006)	Social Support Family	Latino Adults From US	Leisure Time Activity	Not Associated
Fahrenwald (2003)	Helping Relationships	WIC Program Participants	Stage of Change for Physical Activity	$F = 5.67$ $p = .002$
Plotnikoff (2001)	Helping Relationships	Canadian Adults	Stage of Change for Physical Activity	T not given $p = .03$
Rovniak (2002)	General	US College Students	Stage of Change Energy Expend. # Activity Modes	All measured variables correlated; NS w/S-E ¹ , outcome expectations, and self-regulation
Plotnikoff (2008)	General	Canadian Diabetics	Leisure Time Exercise	$r = .26/.19$ NS w/Goals
Castro (1999)	General	Initially Sedentary US women	Walking	$r = .29$ at t1 NS w/S-E & Enjoyment
Calfas (1997)	General (Family & Friends)	Sedentary US Adults	Stage of Change for Physical Activity	$r = .16 - .20$ $p < .05$ NS w/S-E
Eyler (1999)	PASS (Family & Friends)	US Minority, Middle Age and Older Women	Sedentary (vs. Not) Regular Exercise Lifestyle Exercise	Varies by PA Measure and Race/Ethnicity
Wilcox (2000)	General	US Women Older than 40 Years of Age	Leisure Time Physical Activity	OR=.86 (.81-.91) w/o Intention & S-E
Leslie (1999)	General (Friends & Family)	Australian college Students	Sufficient PA	OR Varies by Type and Gender - All Significant
Miller (2002)	Change in Partner Support	Australian Women w/Young Children	Meet PA Guidelines	OR=2.29 (1.46-3.58) w/S-E
Kim (2006)	Helping Relationships	Korean Adults	Stage of Change for Physical Activity	$F = 36.64$ $p < .001$
Sternfield (1999)	General	US Women	Sports & Exercise Active living Household / Care giving Occupational	OR positive & significant for Sports & exercise and for Active living

Table 2.12 continued

Studies evaluating the association between general measures of social support and physical activity

Reference	Construct	Sample	Dependent Construct	Finding
Cardinal (2003)	Helping relationships	US Adults with disabilities	Leisure time exercise	Associated with stages of change
Courneya (2000)	General	Canadian Adults	Stage of Change for Exercise	$b=.09$ $p < .001$ w/Intention, PBC, & Attitude
Marquez (2006)	Social Support Friends	Latino Adults From US	Leisure Time Activity	$F=6.78$ $p < .01$ w/S-E & Perceived Importance

1. S-E = Self-efficacy

Types of social support

Eight research reports describe tests of association between specific types of social support and physical activity. Okun and colleagues (2003) found that informational social support was correlated with total leisure time exercise ($r=.20$, $p < .001$). It was not, however, independently associated with any intensity level of leisure time exercise or with total leisure time exercise when evaluated with a model that included perceived behavioral control, attitude, subjective norm, and intention. Chogahara (1999) also found that informational social support was not independently associated with leisure time energy expenditure, regardless of the source of information (family, friend, or expert). This result was obtained in a regression analysis that contained demographic and social support variables, but not potential psychological mediators. Taken together, these findings offer limited, but consistent evidence that informational social support is not independently associated with physical activity.

On the other hand, Okun and associates (2003) did find that appraisal social support (constructed as “esteem”) was independently associated with both strenuous leisure time exercise ($b=.46$, $p < .001$) and total leisure time exercise ($b=.35$, $p < .001$) in

analyses that included perceived behavioral control, attitude, subjective norm, and intention. Two other reports evaluated appraisal social support, as well. Booth and colleagues (2000) found that reports from significant others that activity was good for the subjects' appearance was positively associated ($p < .01$) with the likelihood that the subjects (older Australians) would be classified as active, as opposed to inactive. This relationship was not found to be significant in regression analysis, although the authors suggest that the model contained a large number of confounded variables that may have resulted in negative outcomes that did not accurately represent the actual relationships among concepts. This notion is further supported by the fact that self-efficacy was excluded from the regression analysis, thus eliminating the possibility of mediation as an explanation for the null regression finding regarding appraisal social support. Chogahara (1999) also found that appraisal social support was independently associated with leisure time energy expenditure, regardless of the source of information. The strongest association was found for esteem support from friends ($b=.26, p < .001$), followed by esteem support from family ($b=.23, p < .001$), and experts ($b=.14, p < .05$). As discussed above, this result was obtained in a regression analysis that contained demographic and social support variables, but not potential psychological mediators. On the basis of these few studies, it is unclear whether esteem social support is independently associated with physical activity.

While instrumental social support includes a variety of possible forms, it was constructed as "companionship" in the four studies reported here. Chogahara's analysis of companionship support identified one independent association, that of friend

relationships ($b=.16$, $p < .01$). Neither family nor expert companionship was significantly related to physical activity in regression analysis. Okun and associates (2003) found that a compound measure of companionship social support was not associated with light, moderate or total leisure time exercise. It was, however, negatively and independently associated with strenuous leisure time exercise, suggesting that those who participated in strenuous leisure time activity were less likely to report participation with family, friend, or experts compared to those who engaged less often in exercise of this intensity level. Booth and colleagues (2000), on the other hand, found subjects who participated with friends or family were more likely to be physically active than those who were not. This regression analysis did not include self-efficacy, thus reducing the evidentiary weight of this study. The most positive finding regarding the relationship between companionship social support and physical activity is provided by Giles-Corti and Donovan (2002). They found an independent association between the number of significant others who exercise with the respondent and the likelihood of the individual meeting activity guidelines. This model included perceived behavioral control and intention and resulted in positive findings for respondents having one (OR = 1.75, CI = 1.34-2.29), two (OR = 2.18, CI = 1.46-3.04), or three (OR = 1.92, CI = 1.05-3.59) companions, as opposed to none. As with informational social support, the evidence regarding an independent association between instrumental support (companionship) and physical activity is mixed and not decisive.

Three studies explicitly addressed the relationship between emotional support (constructed as encouragement or reassurance of worth) and physical activity. Courneya

and McAuley (1995) found that reassurance of worth was not correlated with attendance in an exercise class. Lian and colleagues (1999) found that encouragement from family members was associated with leisure time physical activity for older Singaporeans ($b=.13$, $p < .001$ for males and $b=.15$, $p < .001$ for females). This finding was produced with a regression model that included sociodemographic factors, barriers to physical activity, knowledge of benefits of physical activity, the descriptive norm for physical activity, fruit consumption, and smoking. It did not include potential psychological mediators. Phongsavan, McLean, and Bauman (2007) found that only women's physical activity was associated with encouragement from family and friends. The limited and mixed evidence regarding a relationship between emotional social support and physical activity is inconclusive. Given the variety in the findings, it may be that age and gender define boundary conditions that constrain this relationship.

Summary: Evidence of a relationship between social support and physical activity

The evidence of an association between physical activity and social support is clear. What is not clear from the evidence presented in the 26 papers presented here is whether the association is independent or is completely mediated by psychological factors such as self-efficacy for physical activity. These reports present mixed evidence regarding such a relationship for both social support as a general construct, as well as for the emotional, instrumental, and appraisal types of social support. There is consistent, if limited evidence that informational social support is not independently associated with physical activity.

Findings: Social support and intention to participate in physical activity

Five studies report findings regarding the relationship between social support and intention to participate in physical activity. Courneya and McAuley (1995) found no correlations between subscales representing social support (informational, instrumental, and emotional) and intention to participate in physical activity. Okun and colleagues (2003), on the other hand, found correlations for subscales of social support (instrumental – $r = .23$, $p < .01$; appraisal – $r = .33$, $p < .01$; information – $r = .18$, $p < .01$) with intention. None of these relationships were found to be significant in hierarchical regression analysis that included attitude and perceived behavioral control, however. Similarly, Rovniak and associates (2002) found social support to be correlated with goals ($r = .34$, $p < .01$) and plans ($r = .30$, $p < .01$) but did not find an independent association in a structural model. It must be noted that her model failed to include a path between social support and the latent “self-regulation” factor composed of goals and plans. For this reason, her findings are not strong evidence against such a relationship.

Two studies do provide direct regression evidence of an independent association between social support and intention to be physically active. Plotnikoff and associates (2008) found that social support was directly associated with goal setting for physical activity by those with Type II diabetes, although not for those with Type I. The association was small, but significant ($b = .05$, $p < .01$). Courneya and associates (2000) found an independent association ($b = .11$, $p < .001$) between social support and intention to be physically active in a regression model that included both attitude and perceived

behavioral control. In this study, both constructs were assessed with single items, and the social support item was non-specific in terms of both source and type of social support.

It can be argued that Plotnikoff's and Courneya's positive findings and Okun's negative finding constitute the strongest evidence regarding the extent of the relationship between social support and intention to participate in physical activity. All three studies employed large samples with Okun's being the smallest (363) vs. Plotnikoff's sample of 2,319 and Courneya's sample of 1,557. Courneya's sample was the least idiosyncratic, composed of free living Canadian adults reached through telephone interviews as opposed to the diabetics studied by Plotnikoff and the college students studied by Okun. Based on these distinctions, it may be true that social support may be generally associated with intention to participate in physical activity, but boundary conditions might limit the robustness of the finding. This evidence is judged sufficient here to justify a hypothesis test. Table 2.13 provides a summary of the findings regarding the relationship between social support and intention.

Table 2.13 Studies evaluating the association between measures of social support and intention to participate in physical activity

Reference	Construct	Sample	Dependent Construct	Finding
Courneya 1995	General	US college students	Intention	No Correlation
Okun 2003	Informational	US college students	Intention	$r = .20$ $p < .001$ NS w/Intention, S-E ¹ , Attitude, & DN
Okun 2003	Companionship	US college students	Intention	$r = .22$ $p < .001$ NS w/Intention, S-E, Attitude, & DN ²
Rovniak 2002	General	US college students	Self-regulation	$r = .30-.34$ $p < .01$ NS w/ S-E
Plotnikoff 2008	General	Canadian diabetics	Goals	$b = .05/.04$ $p < .01$ only for Type II w/ S-E and outcome expectations
Okun 2003	Esteem	US college students	Intention	$b = .35$ $p < .001$ w/Intention, S-E, Attitude, & DN
Courneya 2000	General	Canadian Adults	Intention	$b = .11$ $p < .001$ w/PBC ³ & Attitude

1. S-E = Self-efficacy

2. DN = Descriptive Norm

3. PBC = Perceived Behavioral Control

Findings: Social support and self-efficacy for physical activity

Five studies were found that assessed the relationship between social support and self-efficacy for physical activity. Of these, two found no association between a single dimension of social support and a construct representing self-efficacy for physical activity. Both Courneya and McAuley (1995) and Okun (2003) found that informational support was unrelated to perceived behavioral control. Courneya and colleagues (2000) found a small correlation ($r = .17$, $p < .001$) between a general measure of social support and perceived behavioral control, but did not test these relationships in regression analyses.

Four studies assessed the relationship between social support and a self-efficacy construct through regression analysis. Three of these (Courneya and McAuley, 1995; Rovniak et al., 2002 and Plotnikoff et al., 2008) found relationships between an undifferentiated measure of social support and a self-efficacy construct. Rovniak and associates (2002) reported a beta value of .39 in a structural equation model that included paths between social support and self-efficacy, but with no other variables. Plotnikoff and associates (2008) found that a general measure of social support was independently associated with self-efficacy for physical activity for both Type I diabetics ($b=.21, p < .01$) and Type II diabetics ($b=.18, p < .01$). Unlike Rovniak and associates' model (2002), this structural model included a path between social support and goals. Courneya and McAuley (1995) found through a series of multiple regression analyses that a composite measure of social support was independently associated with perceived behavioral control ($b=.26, p$ not reported).

One study (Okun et al., 2003) assessed the independence of relationships between differentiated measures of social support and a self-efficacy construct (perceived behavioral control). Their findings were varied, including an independent association between appraisal social support and perceived behavioral control ($b = .30, p = .01$). They also found no independent association between instrumental social support and perceived behavioral control and a negative association between informational support and perceived behavioral control.

In sum, there appears to be a relationship between social support, in general, and self-efficacy for physical activity. While informational social support appears to have

little or no association with physical activity, appraisal, instrumental, and general measures of social support do. Furthermore, both general measures and a specific construct (appraisal) of social support have been found to have independent associations with self-efficacy for physical activity. Table 2.14 summarizes the results of these studies.

Table 2.14 Studies evaluating the association between social support and self-efficacy for participation in physical activity

Reference	Construct	Sample	Dependent Construct	Finding
Courneya 1995	Information	Exercise Class Participants	PBC ¹	No Correlation
Courneya 2000	General	Canadian Adults	PBC	$r=.17, p < .001$
Okun 2003	Companionship	US College Students	PBC	$r=.20, p < .001$ NS w/DN ³ & other SS
Rovniak 2002	General	US College Students	S-E ²	$b=.39, p < .001$
Okun 2003	Informational	US College Students	PBC	$b= -.17, p < .01$ w/DN & other SS ⁴
Okun 2003	Esteem	US College Students	PBC	$b= .30, p < .01$ w/DN & other SS
Courneya 1995	General	Exercise Class Participants	PBC	$b=.26$
Plotnikoff 2008	General	Adult Diabetics	S-E	$b=.21/.18, p < .01$

1. PBC = Perceived Behavioral Control

2. S-E = Self-efficacy

3. DN = Descriptive Norm

4. SS = Social Support

Findings: Social support and anticipated outcomes for physical activity

Five studies reported on the association between social support and anticipated outcomes. Of these, only Courneya and McAuley (1995) found no correlation between any of the social support subscales for informational, emotional, instrumental, or

appraisal support and anticipated outcomes (constructed as attitudes in this study). Courneya and associates (2000) found a correlation ($r=.23$, $p < .001$) between a single item measure of social support and attitudes toward physical activity, but did not assess the relationship through regression analysis.

Three studies found positive correlations between social support measures and anticipated outcomes constructs, but did not find these relations to be supported in regression analysis. Two of these, Rovniak and associates (2002) and Plotnikoff and associates (2008), offered only weak tests of these relationships. Even though the correlations between their social support constructs and anticipated outcome constructs (outcome expectations, in both cases) were comparable in magnitude to other relationships that were specified in structural equation models, the social support – anticipated outcome paths were constrained to zero. While this approach conforms to theory specification, it does not directly test issues of mediation or spurious association. Hence, the acceptable fit statistics of these models is weak evidence of no direct association between social support and anticipated outcomes.

A third study (Okun et al., 2003) assessed relationships between information, appraisal, and emotional aspects of social support with attitude toward physical activity through hierarchical regression analysis. They found that none of these relationships was significant, in spite of significant correlations that varied from .15 to .34. This is the strongest evidence that any association between social support and anticipated outcomes for physical activity is mediated by other factors, perhaps self-efficacy for physical

activity. No studies reported a direct relationship supported by regression analysis.

Table 2.15 summarizes the results of these reports.

Table 2.15 Studies evaluating the association between social support and anticipated outcomes for participation in physical activity.

Reference	Construct	Sample	Dependent Construct	Finding
Courneya 1995	Informational	Exercise Class Participants	Attitude	No Correlation
Courneya 2000	General	Canadian Adults	Attitude	$r = .23$ $p < .001$
Okun 2003	Companionship, Esteem, & Informational	US College Students	Attitude	$r = .15-.34$ NS w/DN ¹
Rovniak 2002	General	US College Students	Outcome Expectations	$r = .22-.29$ $p < .01$ NS w/ S-E ²
Plotnikoff 2008	General	Canadian Diabetics	Outcome Expectations	$r = .26/.24$ NS w/S-E

1. DN = Descriptive Norm

2. S-E = Self-efficacy

Of the five studies presenting evidence on the relationship between general measures of social support and anticipated outcomes for physical activity, there is no support for an independent association. In fact, four of the studies find otherwise, suggesting that there is no independent association between social support and anticipated outcomes for physical activity. Figure 2.9 summarizes the independent associations between social support and physical activity and its psychological mediators.

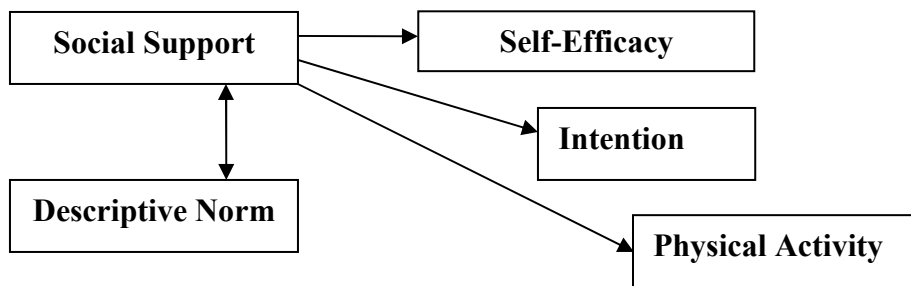


Figure 2.9 Hypothesized associations between social support and other covariates of physical activity and physical activity.

Summary of Social Support with Physical Activity, Intention, Self-Efficacy, and Anticipated Outcomes

Social support appears to be independently associated with physical activity behavior, intention to participate in physical activity, and self-efficacy for physical activity. It is understood in this study to co-vary with the descriptive norm for physical activity and no causal order will be argued for in this document.

A Model of Type of Interpersonal Influence on Physical Activity

A model derived from the literature reviewed above is presented in Figure 2.10. It summarizes in graphic form the associations between variables with moderate to strong evidence of independence. In addition to the independent associations which were at least moderately supported in the literature review, it includes a path representing the association between descriptive norm and anticipated outcomes. This is done because there is a theoretical basis for this association to exist – the observation that others are involved in physical activity communicates a positive value for it – and because the scarcity of research can hardly be judged to provide conclusive evidence against it.

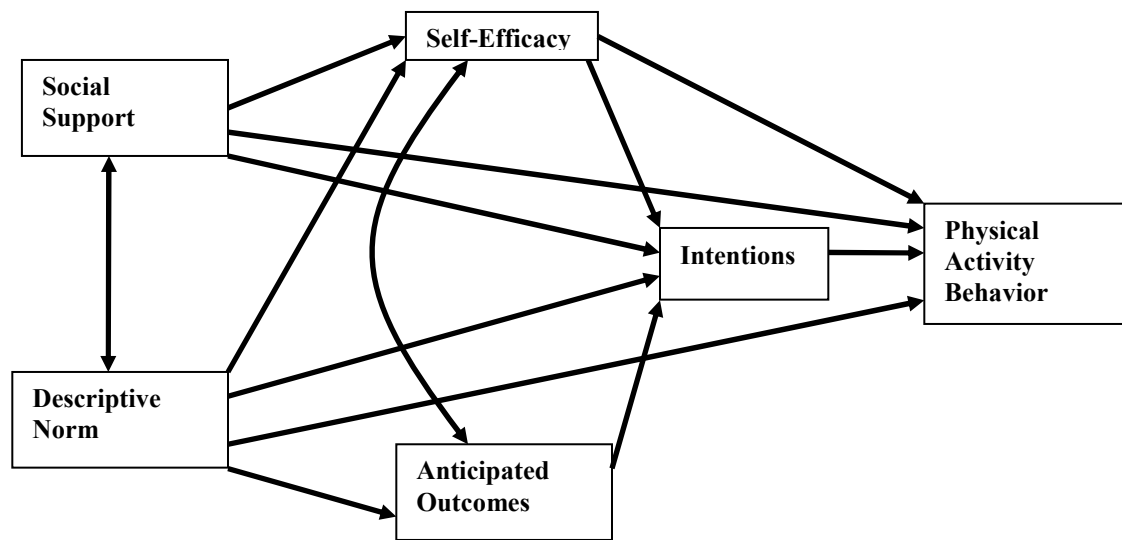


Figure 2.10 An apriori model of interpersonal influence on physical activity derived from the literature.

CHAPTER 3

RESEARCH APPROACH AND RATIONALE

Introduction

The studies reported here drew on longitudinal data from an employee wellness program evaluation at a major healthcare institution in Central Texas. Interpersonal and psychological data from an online, pre-test survey were matched with behavioral data from an online, post-test survey to develop a structural equation model used to estimate patterns of association between interpersonal influence on physical activity, on one hand, and both intention to participate in physical activity and physical activity behavior itself.

This chapter begins with a discussion of the sample in terms of participants and their recruitment, data collection and management procedures, and sample size and characteristics. It follows first with a discussion of operational definitions for the survey items used in data collection and then with a discussion of pilot study results and their implications for the study. It concludes with the data analysis protocols used in the three studies.

Participants

Recruitment

The data in this study were drawn from the Scott & White Attitudes and Habits related to Health Survey, performed at Scott & White Hospital and Clinics in Central Texas. The first wave of data was collected in February of 2008. Follow-up data were obtained during June of the same year. All employees received an email request to

participate in the Scott & White Employee Attitudes and Habits Related to Health Survey (Appendices A and B) which required them to complete two surveys (early February and early June). Employees were told that if they completed both surveys they would be entered into a drawing for one of 30 iPods, each worth approximately \$142 at the time of the initial recruitment.

Data Collection

Email advertisements were run from Friday, February 7th through Tuesday, February 18. Employees were instructed to follow a link embedded in the email if they wished to participate in the survey. Data were collected through Scott & White's subscription to the online survey service, Zoomerang.

A total of 1,242 responses were received to the first survey, of which 1,224 were usable. All time 1 participants were sent email invitations to complete the second survey beginning the 13th of June, with weekly emails sent out during the next two weeks reminding them of their eligibility for the incentive upon completion of the second survey. Five hundred and eighty two responses were received at time 2, of which 474 provided usable interpersonal influence data from time 1 and usable physical activity data from time 2.

Data Management and Protection of Human Subjects

Data were downloaded from the survey database and stored on a laptop, an external hard drive and a thumb drive kept in locked file cabinets, with a file containing name, password and identification code (for matching time 1 and time 2 responses) stored

at the University of Texas and files containing identification codes and responses stored in a locked file cabinet in a private residence. The laptop computer which contained the responses was password protected and remained in the possession of the PI during the course of the study.

The Institutional Review Boards of the University of Texas – Austin and Scott & White Hospital – Temple approved the research protocol for this study. Risk was deemed to be minimal; approvals are provided in Appendices C and D. Participation was voluntary and informed consent was provided through a statement that preceded page one of the surveys when the subject followed the link in the email invitation to the survey.

Sample Characteristics

The characteristics of four samples are presented below. The first (a.k.a. “Total”) is composed of all respondents presenting valid psychological and interpersonal responses at time 1. The second (a.k.a. “Calibration”) is a calibration sample which was generated from the total sample through random assignment of one half of the subjects. The other half of the respondents were assigned to the “Validation” sample. The calibration and validation samples provide the opportunity to replicate findings without increasing the likelihood of Type 1 error in assessments of model fit and identification of significant patterns of association (Joreskog, 1993).

The fourth sample is composed of those respondents presenting valid physical activity data at both time 1 and time 2. Table 3.1 presents the various samples and their uses in the study. This sample was used for testing the ability of interpersonal influence factors to predict physical activity at a later time.

Table 3.1 Analytical uses of various samples.

Sample	Use
Calibration Sample (n=612)	Model development studies 1 and 2
Validation Sample (n=612)	Result replication studies 1 and 2;
Reduced Physical Activity Sample (n=393)	Prediction of physical activity behavior at time 2 using behavioral determinants from time 1.
(Valid T1 Predictive data and T1 and T2 Physical Activity data)	Pre-post physical activity analysis study 3

Total Sample

The total sample was composed of 1224 respondents and was predominantly female (84.6%), white (77.5%), and between the ages of 25 and 54 (78.6%). Most respondents had a minimum of a Bachelor's degree from a four year institution of higher learning (51.2%). Significant racial/ethnic minorities within the population were Blacks (6.6%) and Hispanics (11.4%). Along with those having earned at least a four year college degree, those attending some college (34.3%) and those graduating from high school (14.3%) are well represented. The body composition of the sample is distributed across three categories of body mass index – less than 25 (33.7%), from 25 to less than 30 (28.7%), and 30 and over (37.6%).

Calibration Sample

The calibration sample was composed of the 612 respondents selected at random from the total sample. Like the total sample, this sample was predominantly female

(83.0%), white (75.9%), and aged 25-54 (77.9%). blacks (6.7%) and Hispanics (12.5%) were slightly more prevalent in this sample than in the total sample. College educated respondents were slightly less common in this sample, (50.9%), although those having attended some college were numerous (35.1%). The distribution of the calibration sample across body composition categories was similar to the total sample, although those reporting values less than 25 were slightly represented at a slightly higher rate (34.2%), as were those reporting values in the 25 to less than 30 range (30.7%), while 35.1% reporting BMI levels at or above 30, a rate below that of the total sample.

Validation Sample

The validation sample consisted of the balance of the total sample not assigned to the calibration sample and consisted of 612 respondents. This sample is predominantly female (86.2%), White (77.5%), and has at least a four year college degree (51.4%). Most respondents were between 25 and 64 years of age (79.3%), and 40.1% were obese, more than were either categorized as “overweight” (28.3%) or “normal” (34.3%).

Physical Activity Sample

The physical activity sample is composed of all those with valid physical activity data at both time one and time two (n=393). This sample does not vary significantly from the total sample with regard to any of the personal characteristics.

Sample Comparison

Chi-square analysis of differences between the samples found no difference

between all respondents, the calibration sample respondents, the validation sample respondents, and the physical activity sample respondents when considering the distribution across all categories of sex, race/ethnicity, age, education, and body composition. The same finding holds when education is dichotomized into those with and without at least a four year college degree. No significant difference is observed between time 1 and validation samples for race/ethnicity when respondent classes are dichotomized into White (including Asian) and Non-White. Table 3.2 presents the results of sample comparison tests. Table 3.3 presents the characteristics of the total time one sample, as well as the calibration and validation samples.

Table 3.2. Results of sample comparison chi-square tests (comparisons to total sample).

Characteristic	Calibration Sample Test Results (Sig.)	Validation Sample Test Results (Sig.)	Physical Activity Sample Test Results (Sig.)
Gender ¹	.26	.19	.19
Age ²	.66	.77	.77
Race ²	.97	.95	.95
Education ²	.98	.96	.96
Body Composition ²	.57	.51	.51

1. Fisher's exact test

2. Pearson's Chi-Square Test

Table 3.3 Sample Characteristics – all time 1 respondents, calibration sample, and validation sample.

Characteristic	Value	Time 1 Respondents Frequency (%)	Calibration Sample Frequency (%)	Validation Sample Frequency (%)
Gender		n=1220	n=610	N=610
	Male	188 (15.4%)	104 (17.0%)	84 (13.8%)
	Female	1032 (84.6%)	506 (83.0%)	526 (86.2%)
Race		n=1219	n=610	n=609
	White	945 (77.5%)	463 (75.9%)	482 (77.5%)
	Black	81 (6.6%)	41 (6.7%)	40 (6.6%)
	Hispanic	139 (11.4%)	76 (12.5%)	63 (11.4%)
	American Indian	4 (.3%)	2 (.3%)	2 (.4%)
	Asian	23 (1.9%)	13 (2.1%)	10 (1.9%)
	Hawaiian or Pacific Islander	6 (.5%)	5 (.8%)	1 (.2%)
	Multi-Racial	21 (1.7%)	10 (1.6%)	11 (1.7%)
Age		n=1223	n=611	n=612
	18-24	100 (8.2%)	55 (9.0%)	45 (7.4%)
	25-34	347 (28.4%)	185 (30.3%)	162 (26.5%)
	35-44	315 (25.8%)	142 (23.2%)	173 (28.3%)
	45-54	299 (24.4%)	149 (24.4%)	150 (24.5%)
	55-64	148 (12.1%)	70 (11.5%)	78 (12.7%)
	64 +	14 (1.1%)	10 (1.6%)	4 (.7%)
Education		n=1220	n=609	n=611
	Some HS	3 (.2%)	1 (0.2%)	2 (0.3%)
	HS Grad	174 (14.5%)	84 (13.8%)	90 (15.1%)
	Some College/Post HS	419 (34.3%)	214 (35.1%)	205 (33.6%)
	College Grad	513 (42.0%)	279 (45.8%)	276 (45.2%)
	MD, PhD, JD, DO, Ed.D	114 (9.3%)	31 (5.1%)	38 (6.2%)
BMI		n=1202	n=590	N=594
	Normal	399 (33.7%)	202 (34.2%)	197 (33.2%)
	Overweight	340 (28.7%)	181 (30.7%)	159 (26.8%)
	Obese	445 (37.6%)	207 (35.1%)	238 (40.1%)

Measurement

The items used to assess key concepts are discussed in terms of their response formats, means and standard deviations, and validity.

Physical Activity Behavior

Physical activity is measured using the Global Physical Activity Questionnaire (Bull and Armstrong, 2006). The GPAQ (version 2) was employed here as a measure of physical activity for the following reasons:

1. It differentiates between Total, Leisure Time, Work Time, and Travel Time components of physical activity, and includes items that assess both moderate and vigorous levels of intensity;
2. Its comprehensive nature enables the computation of “MET” units and frequency and duration measures; and
3. Its relative brevity makes it preferable to the IPAQ long form because of its potential to reduce levels of respondent fatigue.

The psychometric qualities of the GPAQ compare favorably to the International Physical Activity Questionnaire – long form (Craig et al., 2003) with which the concurrent validity of GPAQ (version 1) was assessed. A pooled summary of total summary data yielded a correlation of .54 with the IPAQ long form. Correlation between sedentary behavior measures was .65. Criterion validity was judged on the basis of comparisons made to pedometer data. Total physical activity measures showed a fair level of correlation ($r=.31$) and sedentary behavior measures produced a correlation of .26. Bull and Armstrong reported that test-retest reliability was “good to excellent” with correlations varying from .67 to .81.

Subsequent to this evaluation, version two was developed. This effort resulted in the elimination of screening questions (considered redundant) and minor change to wording designed to improve ease of understanding and make it consistent with IPAQ items.

In this study, Total Leisure Time Activity (TLTA) was computed for the physical activity analyses in the third study. TLTA 1 and TLTA 2 (Total Leisure Time Energy Expenditure at times one and two) were computed as the sum of (the product of the number of minutes of moderate leisure time physical activity/week x 4 MET- minutes) and (the product of the number of minutes of vigorous leisure time physical activity/week x 8 MET- minutes). MET units are the ratio of the energy used in a particular activity to the energy spent by the person at rest (Ainsworth, 2002). In this study, moderate intensity activity was estimated as consuming four times the energy used at rest and vigorous activity was estimated to consume eight times the energy used at rest. The items assessing physical activity can be found in the time 1 and time 2 surveys (Appendices A and B). The data cleaning and scoring procedures are presented in Appendix E.

Scoring procedures require the exclusion of cases which contain internally contradictory responses. An example of this would be a person responding “no” to a question which asks if they do vigorous physical activity in their leisure time and next responding that they do so four days/week. Such responses to items assessing leisure time physical activity resulted in the loss of 87 cases in the creation of the Validation data

set from all time 2 respondents.. An additional 81 were lost in the creation of the Reduced Validation sample.

Behavioral Intention

The survey included three items assessing behavioral intention, two expressed positively and one negatively. The two positive items were expressed as intention, whereas the negative item was expressed as an expectation (Rhodes and Matheson, 2005). The items are listed below in Table 3.4 with their means and standard deviations. The questions were prompted with the heading “Your plans for Spring” and were anchored by the evaluations “Strongly Disagree” (1) and “Strongly Agree” (5). In order to achieve a high level of concordance with the primary dependent measure, meeting physical activity guidelines during the spring of 2008, the items specified both the time period and the frequency and duration of physical activity required.

Table 3.4 Survey items assessing behavioral intention for physical activity.

Stimulus	Mean^a (SD)
Most weeks, I will participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day during the next 4 months.	3.29 (1.33)
I am not likely to participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day during the next 4 months.	2.28 (1.32)
I am going to participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day during the next 4 months.	3.42 (1.26)

a. Calibration Sample data.

Self-Efficacy

Self-efficacy was assessed using four items that specified common barriers to physical activity. Two items were taken from Marcus and associates (1994). A third item had been included in worksite wellness programming assessments over a four year period. The final item was adapted to local conditions from one used by Marcus and associates to assess the influence of weather on self-efficacy. The items were prompted with the statement “Circle a number to indicate how confident you are that you could be physically active and/or exercise in each of the following situations.” Response options varied from 1-5 and were anchored by the expressions “Not at all Confident” and “Extremely Confident.” A stem was provided “How confident are you that you could be physically active or exercise when...” and was followed by the four items listed below in Table 3.5.

Table 3.5 Survey items assessing self-efficacy for physical activity.

Stimulus How confident are you that you could be physically active or exercise when	Mean^a (SD)
- you are tired?	2.75 (1.16)
- you feel you don't have much time?	2.71 (1.08)
- your work schedule is tight?	2.71 (1.11)
- the weather is bad (rainy, too hot)?	2.98 (1.21)

a. Calibration Sample data.

Anticipated Outcomes

Anticipated outcomes for physical activity were assessed with six items that consisted of both outcome expectations and outcome expectancy components. Outcome expectancy (Glanz, Rimer, and Lewis, 2002) refers to the value placed on an outcome, whereas the concept outcome expectations refers to the anticipated consequence(s) of behavior. In these questions, the expectancy component was expressed in the stem that precedes the question block: “Please rate how important each of these statements is in your decision of whether to be physically active. In each case, think about how you feel right now, *not how you have felt in the past or would like to feel.*” This prompt was followed by a set of four items expressing positive outcomes and two expressing negative outcomes. Three of the positive items expressed psychological benefits and one expressed a physical benefit, all of which were instrumental in nature because of the delayed aspect of their realization. One negative statement described an instrumental outcome (takes too much time) and the other an affective outcome (does not enjoy the feeling of exercise). The values represent the importance of the outcomes described in each statement with anchors of “Not at all Important” (1) and “Extremely Important” (5). Table 3.6 lists the stimuli and their means and standard deviations.

Table 3.6 Survey items assessing anticipated outcomes for physical activity.

Stimulus Please rate how important each of these statements is in your decision of whether to be physically active. In each case, think about how you feel right now , <i>not how you have felt in the past or would like to feel.</i>	Mean^a (SD)
I would feel more confident if I were regularly physically active.	4.01 (.96)
Regular physical activity would take too much of my time.	2.41 (1.02)
I would feel less stressed if I were regularly physically active.	3.98 (1.02)
I would feel good about myself if I kept my commitment to be regularly physically active.	4.20 (.90)
I do not like the way physical activity and exercise makes me feel bad.	1.85 (1.03)
I would have more energy if I were regularly physically active.	4.21 (.89)

a. Calibration Sample data.

Social Support

Social support was assessed through a set of nine items, three each from various social contexts (occupational, home, and friend). The items were part of a large set of items that assessed various aspects of these social environments. All such items were presented together in tabular form and were prompted by suggestions that the respondent “Think about the place where you work” and “Think about the people you live with and socialize with outside of work.” The responses were anchored by the expressions

Strongly Disagree (1) and Strongly Agree (4) to achieve a forced response judgment (De Vellis, 2003).

Out of the sets of three items, one assessed instrumental support through companionship in physical activity, one addressed emotional support through encouragement, and one assessed the effect of negative interactions through teasing. The positive items were based on items from Sallis and associates (1987), but were expressed in terms of participation in moderate or vigorous physical activity to achieve concordance with the dependent measure. The negative item draws on the findings of Chogaharra (1999) and provides a check against a positive response set. Table 3.7 lists the stimuli and their means and standard deviations.

Table 3.7 Survey items assessing social support for physical activity

Stimulus	Mean^a (SD)
1. My co-workers encourage me to participate in moderate or vigorous physical activity.	2.24 (.94)
2. I participate in moderate or vigorous physical activity with a co-worker.	1.74 (.89)
3. My co-workers tease me about not being athletic.	1.36 (.64)
4. The people I live with encourage me to participate in moderate or vigorous physical activity.	2.71 (.99)
5. I participate in physical activity with a person from my home.	2.32 (1.05)
6. The people I live with tease me about not being athletic.	1.44 (.72)
7. My friends encourage me to participate in moderate or vigorous physical activity.	2.41 (.94)
8. I participate in physical activity with one or more of my friends.	2.13 (.99)
9. My friends tease me about not being athletic.	1.39 (.65)

a. Calibration Sample data.

Descriptive Norm

Six items were used to assess respondent perceptions of the descriptive norms operating in their occupational, home, and friendship environments. These items assessed perceptions of exercise behavior, as well as the frequency with which it was

discussed (Heise, 2006). The items were part of a large set of items that assessed various aspects of these social environments. All such items were presented together in tabular form and were prompted by the expressions “Think about the place where you work” and “Think about the people you live with and socialize with outside of work.” The responses were anchored by the expressions Strongly Disagree (1) and Strongly Agree (4) to achieve a forced response judgment. Table 3.8 lists the stimuli and their means and standard deviations.

Table 3.8 Survey items assessing the subjective, descriptive norm for physical activity.

Stimulus	Mean^a (SD)
1. My co-workers talk about being physically active.	2.73 (.95)
2. My co-workers often participate in moderate or vigorous physical activity.	2.47 (.89)
3. The people I live with talk about being physically active.	2.73 (.95)
4. The people I live with often participate in moderate or vigorous physical activity.	2.51 (1.00)
5. My friends talk about being physically active	2.61 (.88)
6. My friends often participate in moderate or vigorous physical activity.	2.41 (.90)

a. Calibration Sample data.

Pilot Study Results

A pilot study was performed to assess the potential for analyzing the data with structural equation models. The study consisted of univariate distribution (skewness and kurtosis) analysis, power analysis, exploratory factor analysis, internal consistency of scales identified through factor analysis, and correlations among scales representing study variables. The significance of the pilot results for data analysis is discussed.

Analysis of Distributional Properties

Univariate skewness and kurtosis indices were computed for all survey items included in the analysis based on a output from SPSS and a protocol described by Kline (2005). Fifteen of the 28 items used to assess interpersonal and psychological factors displayed skewness and/or kurtosis beyond acceptable levels. Cubic transformation brought skew and kurtosis values within acceptable ranges for all variables.

Missing Data

Eight cases were omitted from the Calibration sample because of missing responses on over half of the items because of the difficulty it presented for imputation of missing values by Mplus.

Power Analysis

The approach for determination of study power is based on a discussion in Kline (2005, pp. 157-158) and is described in detail by MacCallum and colleagues (1996). They provide a schedule for estimating the power of statistical tests performed on

structural equation models based on the degrees of freedom and sample size. In this study, the full models (structural and measurement components) for both apriori and factor analytic approaches yield over 200 degrees of freedom. This exceeds the minimums required for a power estimate of 1.00 with a sample size of 474 (see MacCallum et al., 1996, p. 142) for estimates of close fit, not close fit, and exact fit. It was concluded from this finding that structural equation modeling was supported by the data available for this study.

Exploratory Factor Analysis

Exploratory factor analysis was performed on the calibration sample. A varimax rotation was applied and factors with Eigenvalues greater than 1.0 were extracted. The analysis returned seven factors that met the selection criteria and explained 72.78% of the variance in the matrix. Table 3.9 presents the factors by name and their rotated loadings and percentage of the variance explained.

Table 3.9 Rotated^a factor loadings and % variance explained.

Factor^a	Construct Label	Rotation Sum of Squares Loading	% Variance Explained
1	Self Efficacy for Physical Activity	3.78	12.02
2	Anticipated Outcomes for Physical Activity	3.14	11.12
3	Friend Social Environment	3.04	11.06
4	Home Social Environment for Physical Activity	2.79	9.91
5	Work Social Environment for Physical Activity	2.48	8.25
6	Teasing regarding Physical Activity	2.21	7.62
7	Intention to Participate in Physical Activity	1.94	7.59
8	Negative Outcomes for Physical Activity	1.94	5.23
Total Variance Explained by factors 1-7			72.78

a. Varimax orthogonal rotation.

The factor analysis did not return social support and descriptive norm as factors. Instead, it yielded three social environmental factors corresponding to occupational, home, and friend contexts. In general, these factors were composed of both descriptive norm items and the encouragement and companionship social support factors. In the case of the work environment, however, companionship loaded weakly (.18) and loaded more strongly on the friend social environment (.55). This suggested that exercise companions at work might be friends and, therefore, not distinguishable as being associated with one environment or the other. A self-efficacy factor was composed of the four self-efficacy items, as expected. Finally, the positive anticipated outcome items loaded strongly (all above .78) on the factor which explained the second most variance of any factor. These results suggested that the analysis of interpersonal influence in this study should be conducted in a way that is not consistent with the constructs reported in the literature.

Scale Reliability

The internal consistency of the scales identified through factor analysis was assessed to determine the suitability of the scales for use in regression analysis. This included scales identified through exploratory factor analysis as well as the apriori social influence scales for social support and descriptive norm. Items were not included in multiple factors, but rather only in the factors for which they loaded most heavily. The factor “Intention to participate in physical activity” was analyzed separately from the self-efficacy and negative outcome expectations factors with which its items cross loaded. The analysis of the internal reliability of the factors identified through exploratory factor analysis identified seven scales with reliability scores above .70 which

was considered to be the cutoff for a sufficiently reliable scale (DeVellis, 2003). These included intention to participate in physical activity, self-efficacy for physical activity, positive anticipated outcomes for physical activity, work social environment, home social environment, and friend social environment, and teasing. Scales representing the constructs social support and descriptive norm were also assessed for internal consistency. Table 3.10 summarizes the findings of this analysis.

Table 3.10 Internal consistency of scales identified through exploratory factor analysis.

Factor	Internal Consistency (α)
Intention to participate in physical activity ^a	.84
Self-efficacy for physical activity	.89
Positive Anticipated Outcomes for physical activity	.87
Negative Anticipated Outcomes for physical activity	.59
Work Social Context	.77
Friend Social Context	.84
Home Social Context	.86
Teasing regarding physical activity	.75
Social Support for physical activity	.78
Descriptive Norm for physical activity	.81

a. Negatively expressed item reverse coded

Correlations Among Factors

Bivariate correlations were computed for scales representing the factors included in both models, with listwise deletion of cases with missing data. Accordingly, the correlations are represented in Table 3.11 (for factors included in the apriori model) and Table 3.12 (for factors included in the model derived from exploratory factor analysis) which are found on the following pages.

Intention to participate in physical activity was positively correlated with all factors except teasing ($r = -.05, p < .24$). It was most strongly correlated with self-efficacy ($r = .56, p < .01$) and had correlations that ranged between .24 and .37 with positive anticipated outcomes, descriptive norm, social support, friend social context, and home social context.

Self-efficacy for physical activity was not associated with teasing. It was associated with positive anticipated outcomes ($r = .33, p < .01$), negative anticipated outcomes ($r = -.26, p < .01$), work social context ($r = .24, p < .01$), home social context ($r = .34, p < .01$), and friend social context ($r = .30, p < .01$), descriptive norm ($r = .31, p < .01$) and social support ($r = .38, p < .01$).

Positive anticipated outcomes was associated with negative anticipated outcomes ($r = -.26, p < .01$), work social context ($r = .20, p < .01$), home social context ($r = .31, p < .01$), friend social context ($r = .32, p < .01$), descriptive norm ($r = .36, p < .01$) and social support ($r = .30, p < .01$). Negative anticipated outcomes was positively associated with home social context ($r = .14, p < .01$), friend social context ($r = .13, p < .01$), and teasing ($r = .21, p < .01$).

The descriptive norm was strongly associated with social support ($r = .74, p < .01$) and weakly associated with teasing ($r = .10, p < .05$). Social support was also related to home social context ($r = .72, p < .01$), work social context ($r = .68, p < .01$), friend social context ($r = .83, p < .01$), and teasing ($r = .20, p < .01$).

Friend social context was moderately correlated with both home social context ($r = .53, p < .01$) and work social context ($r = .52, p < .01$). Home and work social contexts were less strongly correlated ($r = .31, p < .01$). Friend social context was weakly associated with teasing ($r = .18, p < .01$). Home social context was weakly related to teasing ($r = .10, p < .05$), as was work social context ($r = .12, p < .01$).

Table 3.11 Bivariate correlations, means, and standard deviations of variables included in the apriori model.¹

Variable	1	2	3	4	5	6	7
1. Intention	—						
2. Self-efficacy	.56**	—					
3. Positive Anticipated Outcomes	.37**	.33**	—				
4. Negative Anticipated Outcomes	-.35**	-.26**	-.26**	—			
5. Social Support	.36**	.38**	.30**	-.08	—		
6. Descriptive Norm	.35**	.31**	.36**	-.11**	.74**	—	
7. Teasing	.05	.04	.11*	.21**	.20**	.10*	—
Mean	3.48	2.79	4.11	2.13	.26	2.57	1.39
Standard Deviation	1.13	1.00	.82	1.63	.67	.65	.54

1. Correlations, means, and standard deviations computed on the calibration data set.

** Correlation is significant at the .01 level.

Table 3.12 Bivariate correlations, means, and standard deviations of variables identified through exploratory factor analysis.¹

Variable	1	2	3	4	5	6	7	8
1. Intention	—							
2. Self-efficacy	.56**	—						
3. Positive Anticipated Outcomes	.37**	.33**	—					
4. Negative Anticipated Outcomes	-.30**	-.11	-.24**	—				
5. Work Social Context	.24**	.24**	.20**	.00	—			
6. Friend Social Context	.35**	.30**	.32**	-.13	.52**	—		
7. Home Social Context	.33**	.34**	.31**	-.10	.31**	.53**	—	
8. Teasing	-.09*	.04	-.11*	.21**	-.12**	.18**	.10*	—
Mean	3.48	2.79	4.11	2.13	2.30	2.38	2.58	1.39
Standard Deviation	1.13	1.00	.82	1.63	.71	.78	.82	.54

1. Correlations, means, and standard deviations computed on the calibration data set.

** Correlation is significant at the .01 level.

Discussion of Pilot Study Results

The transformed data were deemed to be suitable for regression analysis with standard maximum likelihood estimation. Degrees of freedom were sufficient to provide predictive power.

Scales assessing social support, descriptive norm, the work, friend, and home social contexts, self-efficacy, positive anticipated outcomes, and intention to participate in physical activity each displayed sufficient internal consistency to suggest that they may be used to produce relatively stable estimates of associations among their respective constructs. While the scale for negative anticipated outcomes falls below the recommended internal consistency level (.59 as opposed to the .70 standard), there were two reasons to include it in initial modeling. On one hand, items assessing negative anticipated outcomes may be very different in nature and are, therefore, not as likely to

be highly correlated as other indicators of latent factors. The strength of association between negative anticipated outcomes and behavioral intention also points to their potential value in the overall model. Finally, the consistent association between perceived barriers and physical activity in the literature suggests that the items tap a critical theoretical construct. Figure 3.1 presents a Social Context Model of Interpersonal Influence on Physical Activity derived from the pilot study results.

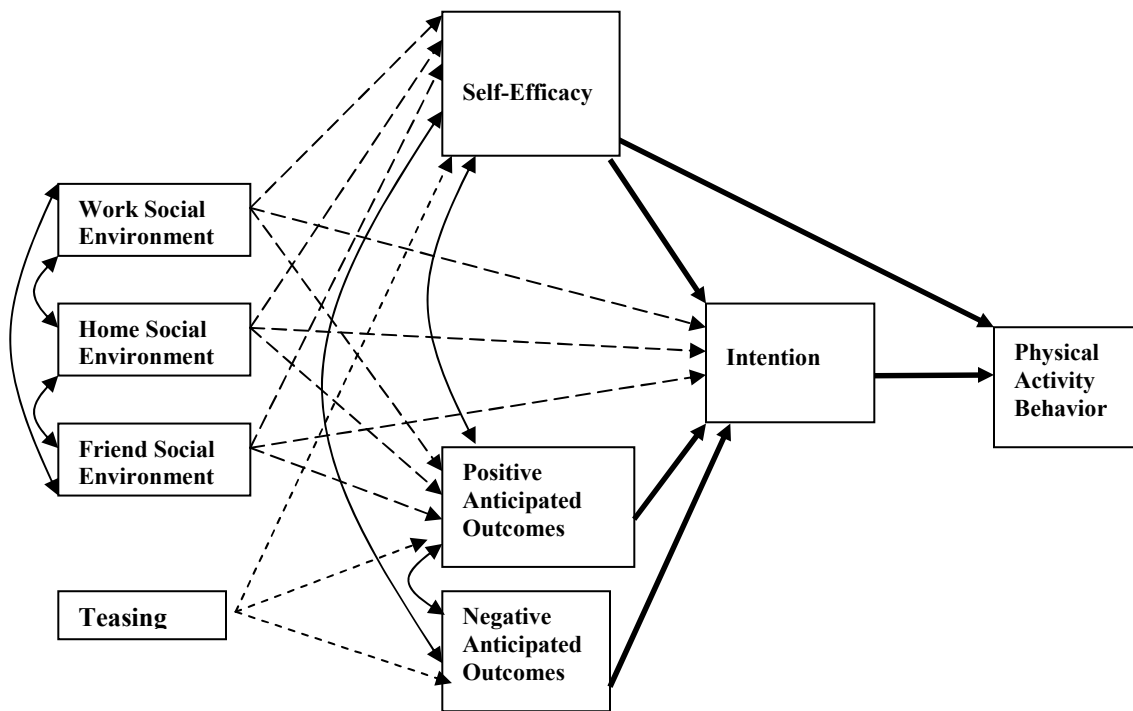


Figure 3.1 A Social Context Model of Interpersonal Influence on Physical Activity derived from the pilot study results.

Data Analysis

The data analysis procedures employed in the three studies are described below.

Study 1

Purpose

The purpose of study 1 was to identify the preferred method for assessing interpersonal influence. An undifferentiated model of interpersonal influence was compared to a two factor model based on social support and descriptive norm and a three factor model based on work, home, and friend social contexts.

Approach

Three models were specified for confirmatory factor analysis of interpersonal influence on physical activity. A one factor model called the Generalized Model of Interpersonal Influence included all social support and descriptive norm items (12 in all) and was evaluated first. The second model called Type of Influence and based on the constructs social support and descriptive norm was evaluated next. The final model, called social context was based on exploratory factors analysis and composed of three constructs – work social context, home social context, and friend social context. Figures 3.2, 3.3, and 3.4 on the following pages depict the baseline one, two, and three factor models to be evaluated in this study.

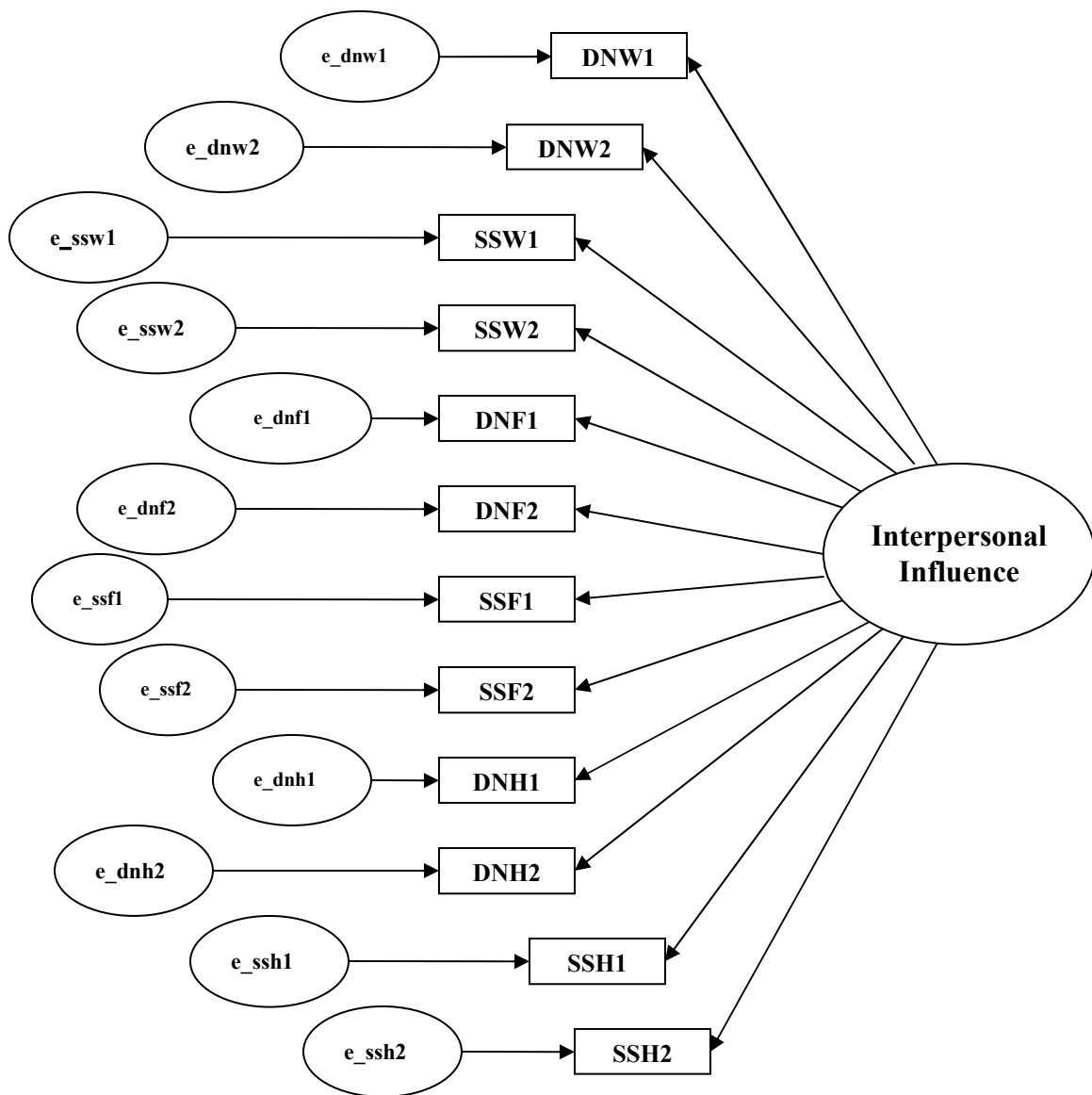


Figure 3.2. The baseline Generalized Model of Interpersonal Influence.

DN	Descriptive Norm
SS	Social Support
W	Work Context
H	Home Context
F	Friend Context
e_	error term for that indicator

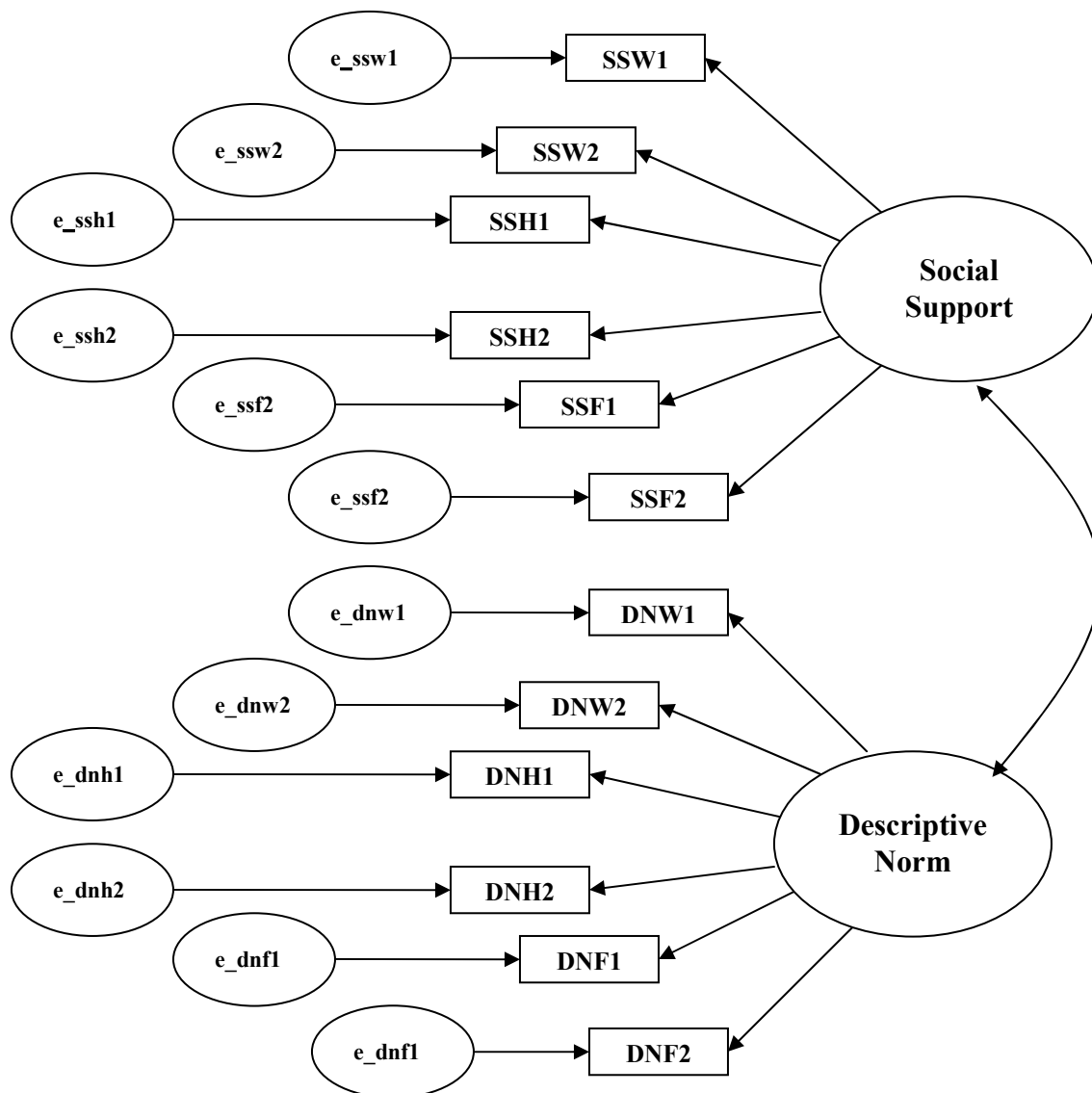


Figure 3.3 The baseline Type of Influence Model of Interpersonal Influence (two factor model).

DN	Descriptive Norm
SS	Social Support
W	Work Context
H	Home Context
F	Friend Context
e_	error term for that indicator

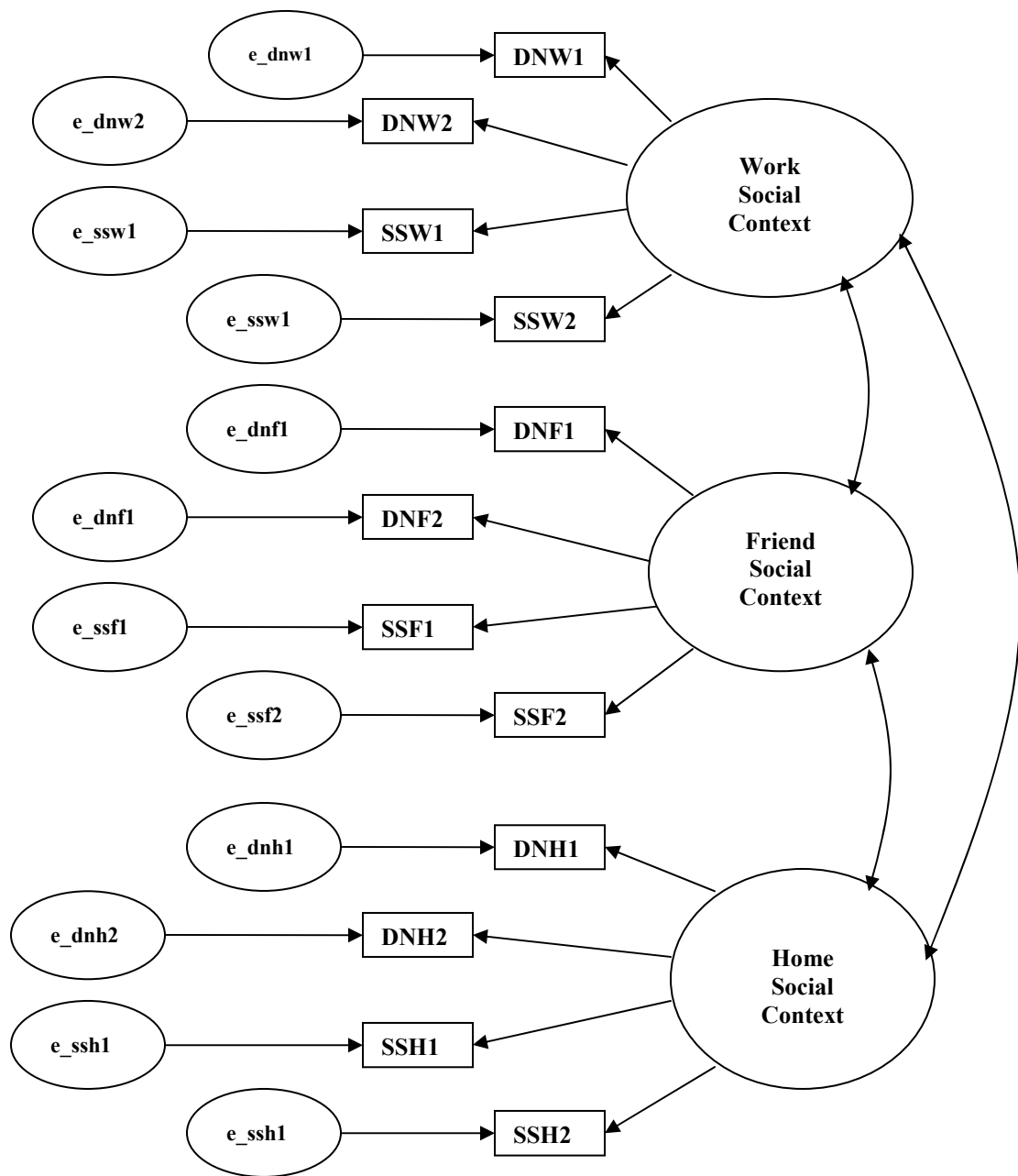


Figure 3.4. The baseline Social Context Model of Interpersonal Influence.(three factor model).

DN	Descriptive Norm
SS	Social Support
W	Work Context
H	Home Context
F	Friend Context
e_	error term for that indicator

Model Selection

The selection of the best of these competing approaches to modeling interpersonal influence was based on model fit, convergent validity, discriminant validity, explained variance of the indicators, and internal consistency. Baseline models were estimated with all indicators being determined only by a single factor and an error term.

Model fit was judged on the basis of model χ^2 /degrees of freedom, CFI, AIC, RMSEA, and SRMR. For large samples Kline (2005) recommends using the model χ^2 /degrees of freedom ratio as an indicator of model fit and suggests that values of 3.0 or less are deemed acceptable. The Comparative Fit Index (CFI) provided an incremental measure of model fit based on a comparison to a null model in which no variables were correlated. Values of .90 and above were considered acceptable for this index (Kline, 2005). The Aikake Information Criterion is a parsimony adjusted measure that was useful in the comparison of non-hierarchical models, such as was the case in this study (Kline, 2005; Wang and Liu, 2006). The smaller value in a comparison of AIC values was considered representative of a better fitting model. The Root Mean Square Error of Approximation (RMSEA) provided for estimates of good model fit and was more appropriate to over-identified models than procedures comparing models to a standard of perfect fit. Point estimates, 90% confidence intervals, and a probability of good model fit were provided in output by Mplus. Hypothesis rejection was judged on the confidence intervals, although all statistics are commonly reported. Values of .05 and below were indicative of good model fit, between .05 and .08 indicate acceptable fit, and those equal to or greater than .10 were considered indicative of poor fit (Kline, 2005; Browne and

Cudeck, 1993). The Standardized Root Mean Square Residual provided an estimate of the mean correlation residual, which was understood to be the difference between the correlations that are predicted and observed (Kline, 2005). Values of less than .10 were considered indicative of good fit.

Convergent validity in a factor model was judged on the basis of the magnitude of the factor loadings, compared item by item across models (Kline, 2005). Loadings of greater magnitude provide evidence that the indicators were more strongly associated with the factor being studied. Discriminant validity was based on the magnitude of correlations between factors. Correlations above .85 were indicative of collinearity between factors rather than differentiability (DeVellis, 2003). Explained variance, as noted by DeVellis (2003), was an important consideration in developing scales with predictive validity. Higher levels of explained variance in a scale suggested the potential for greater predictive validity, all other factors being equal. The internal consistency of the scales associated with each of the three models tested was assessed in terms of Chronbach's alpha as computed by SPSS 16.0. Values of .70 and above are considered a minimum standard for the internal consistency of most scales (DeVellis, 2003).

Model development and replication

The model with the best evaluation in terms of the above criteria was subjected to refinement to improve model fit. Two types of changes to the model arose out of the development process. The item assessing co-worker participation in physical activity was modeled as an indicator for both friend and work social contexts. This is consistent with the results of a preliminary exploratory factor analysis that found this item loaded

onto both of these factors and with the expectation that the influence of the factor friend social context might overlap with both work and home contexts for many respondents.

Assuming a significant modification index value, error correlation was allowed for items which could be subject to response set, such as those which were consecutive in their presentation in the survey and for those of similar type such as social support items or descriptive norm items from different social contexts. Non-significant error correlation paths were trimmed on the basis of negative model χ^2 difference test results. The last step in the analysis involved fitting the final confirmatory factor model with all modifications to the validation sample for purposes of replication. All of these paths associated with significant modification index values greater than 3.84 (Kline, 2005) were added to the baseline model to improve model fit.

The refined model was tested on the validation sample for replication of results. The first four fit measures described above (model χ^2 /d.f., CFI, RMSEA, and SRMR) were employed in this procedure. No model refinement was attempted with the validation sample data.

Study 2

Purpose

The first purpose of the second study was to develop a parsimonious, mediational model of social influence on intention to participate in physical activity. The second purpose is to assess the moderating impact of personal characteristics on the model.

Approach

The approach employed here is based on Joreskog's discussion of model development (1993). This approach requires the development of single factors with good fit that are then linked together first as a pair and then as larger sets of factors. In this study, the social context factors were introduced as a set having been developed in a previous study. The psychological factors self-efficacy, positive anticipated outcomes, negative anticipated outcomes, behavioral intention and the negative social influence factor "Teasing" were all constructed through confirmatory factor analysis.

Finally, the psychological and social context factors were combined in a model that tested for associations between each of the social context factors and each of the psychological factors. The resulting model is referred to as the baseline model and was retained for analysis.

Analysis

The baseline model was fitted to the calibration data set using Mplus 5.1 (Muthen and Muthen, 2007). Model fit was determined by four factors – model $\chi^2/\text{d.f.}$; C Fit Index (CFI); Root Mean Square Error of Approximation (RMSEA); and Standardized Root Mean Square Residual. Kline (2005) recommends using the model $\chi^2/\text{degrees of freedom}$ ratio as an indicator of model fit for large samples and suggests that values of 3.0 or less are deemed acceptable. The Comparative Fit Index (CFI) provided an incremental measure of model fit based on a comparison to a null model in which no variables are correlated. Values of .90 and above were considered acceptable for this index (Kline, 2005). The Root Mean Square Error of Approximation (RMSEA) provided

for estimates of good model fit and was more appropriate to over-identified models than procedures comparing models to a standard of perfect fit. Point estimates, 90% confidence intervals, and a probability of good model fit were provided in output by Mplus. Hypothesis rejection was judged on the confidence intervals. Values of .05 and below were indicative of good model fit, between .05 and .08 indicated acceptable fit, and those equal to or greater than .10 were considered indicative of poor fit (Kline, 2005; Browne and Cudeck, 1993). The Standardized Root Mean Square Residual provided an estimate of the mean correlation residual, which is understood to be the difference between the correlations that are predicted and observed (Kline, 2005). Values of less than .10 are considered indicative of good fit.

Moderation

The structural equation model used to evaluate associations between interpersonal influence and behavioral intention was used to test for moderation by age, educational attainment, and body composition. Age was assessed by comparing those younger than 45 years of age with those 45 years of age and older. Educational attainment was assessed for a moderating association by comparing those with at least a four year college degree with those who did not obtain a four year postsecondary degree. Body composition was assessed for moderating association by comparing obese (BMI greater than or equal to 30) and non-obese individuals.

First, multi-group models were allowed to vary freely across paths using the calibration sample data. Next, each path in the structural model was constrained to be equal across groups, one path at a time. The decrement in model fit was assessed by χ^2

difference testing. Path constraints associated with a minimum threshold value of 3.84 or greater were considered to significantly decrease model quality judged to be unequal across groups.

A final test of difference between groups involved the fitting of a model with an equality constraint placed on all paths not found to be different through the single path constraint method used in the previous step. This “final” model was compared to the original model with no paths constrained. If this model did not represent a significant decrement in model fit based on the χ^2 difference test employed in step 2, it was accepted as a parsimonious model of the data. Paths which were allowed to vary across groups in this model were considered to represent best estimates of between group differences in associations between factors.

Study 3

Purpose

The first purpose of study 3 was to develop a predictive, mediational model for the association between interpersonal influence and physical activity. The second purpose was to test for moderation of the model by personal factors.

Approach

This study began with the Social Context Model of Intention to Participate in Physical Activity that was developed in the previous study. The analysis employed the 393 person data set with both time 1 and time 2 total leisure time physical activity.

Figure 3.5 presents the Social Context Model of Interpersonal Influence on Physical Activity that was tested in this study.

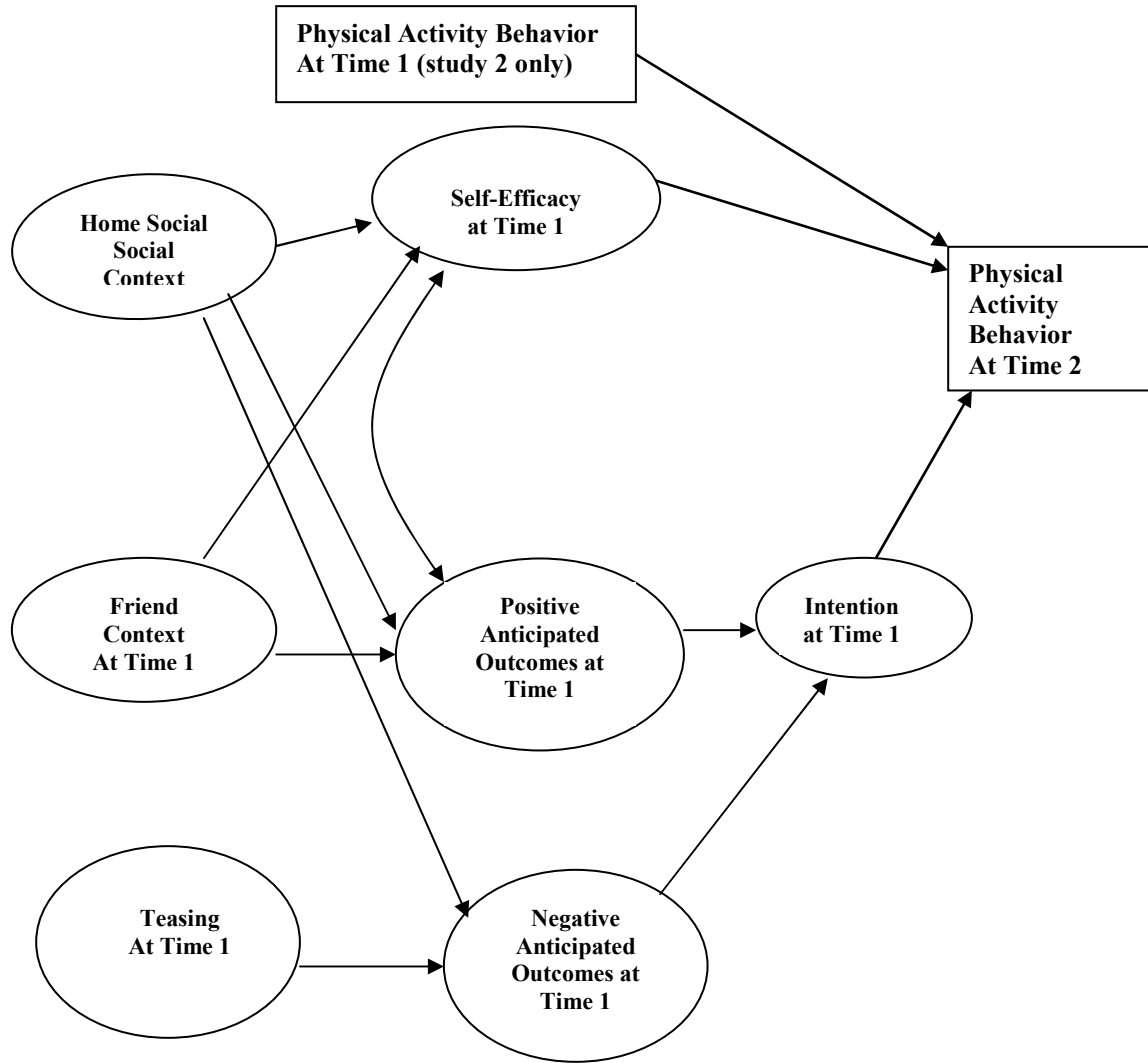


Figure 3.5. The Social Context Model of Interpersonal Influence on Physical Activity.

Model fit

A baseline structural equation model was fitted to the physical activity data set using Mplus 5.1 (Muthen and Muthen, 2007) for analysis. Kline (2005) recommends the evaluating model fit in terms of four factors – model χ^2 /d.f.; Comparative Fit Index (CFI);

Root Mean Square Error of Approximation (RMSEA); and Standardized Root Mean Square Residual. For large samples, the model $\chi^2/\text{degrees of freedom}$ ratio is used as an indicator of model fit and values of 3.0 or less are acceptable. The Comparative Fit Index (CFI) provides an incremental measure of model fit and values of .90 and above are considered acceptable. The Root Mean Square Error of Approximation (RMSEA) provides for estimates of good model fit and is more appropriate to over-identified models than procedures comparing models to a standard of perfect fit. Point estimates, 90% confidence intervals, and a probability of good model fit are used to determine hypothesis evaluation. Values of .05 and below are indicative of good model fit, between .05 and .08 indicate acceptable fit, and those equal to or greater than .10 are considered indicative of poor fit. The Standardized Root Mean Square Residual provides an estimate of the mean correlation residual; values of less than .10 are considered indicative of good fit.

Moderation testing

Multi-group models were used to assess moderation by age, educational attainment, and body composition. Age was assessed by comparing those younger than 45 years of age with those 45 years of age and older. Educational attainment was assessed for a moderating association by comparing those with at least a four year college degree with those who did not obtain a four year postsecondary degree. Body composition was assessed for moderating association by comparing obese (BMI greater than or equal to 30) and non-obese individuals.

First, multi-group models were allowed to vary freely across paths using the validation data. Next, each path in the structural model was constrained to be equal across groups, one path at a time. The decrement in model fit was assessed by χ^2 difference testing. Path constraints associated with a minimum threshold value of 3.84 or greater were considered to significantly decrease model quality judged to be unequal across groups.

A final test of difference between groups involved the fitting of a model with an equality constraint placed on all paths not found to be different through the single path constraint method used in the previous step. This “final” model was compared to the original model with no paths constrained. A model that did not represent a significant decrement in model fit based on the χ^2 difference test employed in step 2, was accepted as a parsimonious model of the data. Paths which were still observed to vary across groups in this model were considered to represent best estimates of between group differences in associations between factors.

CHAPTER 4

THE DEVELOPMENT OF A SOCIAL CONTEXT BASED SCALE OF INTERPERSONAL INFLUENCE ON ADULT PHYSICAL ACTIVITY

Introduction

Christakis and Fowler (2007) found that individuals who became obese during a given time period were more likely than their peers to have a friend become obese in a subsequent time period. Obesity is associated with a number of chronic diseases including cardiovascular disease, diabetes, and some cancers (Centers for Disease Control). Along with nutrition, physical activity is a key factor in weight loss and subsequent weight maintenance for obese and overweight individuals (National Institutes of Health, 1998). This paper describes the development of a scale that is designed to provide a more comprehensive approach to the measurement of interpersonal influence on physical activity than is currently in use.

Types and Sources of Interpersonal Influence on Physical Activity

Interpersonal influence is derived from two sources – perceptions of social norms and that which is derived from patterns of exchange relations. Two aspects of social norms have been studied for their influence on physical activity behavior – the injunctive norm and the descriptive norm. The former is understood to be a person's perception of what his/her significant others believe he/she should do. This concept was included in considerable research based on the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the Theory Planned Behavior (Ajzen, 1991) but has not been found to be consistently

associated with general measures of physical activity (Troost et al., 2002; Sallis & Owen, 1999). Okun and colleagues (2002) make the point that the injunctive norm appears to be a more effective predictor of negatively sanctioned behaviors than it is of positive ones. Perhaps the approval of others, especially for adults, is less a motivating force than is other evidence of appropriate behavior.

In this vein, two research programs point the way to an alternative approach to assessing normative influence. Bandura's work on social learning (1986) makes clear the importance of observing others in the environment as a means for learning about acceptable and/or desirable behavior. The research of Reno, Cialdini, and Kallgren (1990) reaffirms the importance of the perceived behavior of others as a cue to appropriate behavior. It is not surprising, that in recent years attention has shifted to the descriptive norm, "...the way that most people act..." (Lewis, DeVellis, & Sleath; 2002:242), which has shown some promise for health behavior research, in general, (Rivis & Sheeran, 2003a) and physical activity behavior, in particular (Okun et al., 2002; Okun et al., 2003; Rivis & Sheeran, 2003a).

Despite this increased attention, a comprehensive approach to measuring the descriptive norm for physical activity has not been developed. Ajzen (2002) described a general approach to assessing the descriptive norm. Fishbein included the descriptive norm in the latest version of the Integrated Behavioral Model (Montano & Kasprzyk, 2008). These approaches were consistent with previous Theory of Planned Behavior work in that they focused on significant others and followed the same measurement approach. But Cialdini, Reno, & Kallgren (1990) had already established the importance

of a broader and more diffuse set of influences in their definitive work. This research focused primarily on people's observations or visual evidence of behavior in public spaces. Accordingly, the descriptive norm should address both significant others and those not directly known by the actor at the center of analysis.

Social psychologist David Heise (2006) expanded the notion of normative influence further in his recent writings. He pointed out that "Your public acts and comments influence others and shape their social acts" (2006; 13). From this perspective, both physical activity behavior and talking about physical activity are components of the descriptive norm. It is this broader understanding that underlies the measurement of normative influence in the current study.

In physical activity research, two general approaches have been used to assess the descriptive norm. Some researchers ask survey respondents if they commonly observe others participating in physical activity in their neighborhood. Booth and associates (2000) found that the observation of others being active was not associated with physical activity, but King and colleagues (2000) found no association between "seeing others walking" and inactivity. These assessments of the association between the general social milieu and behavior are not conclusive.

The second general approach that has been used has focused on understanding the effect of the behavior of either members of one's family (generally defined as nuclear family) or one's friends. The evidence regarding an association between family and friends and one's own behavior is also mixed, but a bit more plentiful and favorable. Perhaps the strongest evidence of an association between the normative behaviors of

significant others and behavior of a survey respondent is offered by Okun and colleagues (2003). They found an independent association ($b = .14$; $p < 0.01$) between the perceptions of the behavior of friends and one's own level of strenuous activity, even when social support and psychological mediators were included in a regression model. Booth and associates (2000) and Ravis and Sheeran (2003) found bivariate associations between the perception of the frequency with which one's significant others participate in physical activity and one's own participation level. Balanced against this is the finding of Jackson and colleagues (2003) of a positive correlation, but no independent association between the descriptive norm and leisure time exercise. Although the paucity of research precludes any strong conclusions about the utility of the descriptive norm as a determinant of physical activity behavior, it is reasonable to include it in exploratory analysis at this point.

The second source of interpersonal influence considered in this review is exchange relationships, i.e., patterns of social interaction in which both parties realize some benefit owing directly to the relationship (Emerson, 1992). Interpersonal relationships that facilitate physical activity for one or more persons involved in the exchange are considered social support for physical activity. House (1981), as cited in Heaney and Israel, refers to social support as the "functional content of relationships" (2002:186). Heaney and Israel note that this content can be categorized as informational, instrumental, emotional, and/or appraisal. According to Israel (1982) and House (1981), the types of social support are defined in Table 4.1 below:

Table 4.1 Forms of social support

Type of Social Support	Definition	Operational Approaches
Emotional Support	Expressions of empathy, love, trust, and caring	Encouragement to participate in physical activity; Sympathizing with actor's comments on the difficulty of physical activity
Instrumental Support	Tangible aid and service	Helping with childcare or chores to enable the actor to participate in physical activity; Serving as a companion for physical activity.
Informational Support	Advice, suggestions, and information	Explaining how to manage regular physical activity; Explaining where to find appropriate clothing for physical activity
Appraisal Support	Information that is useful for self-evaluation	Self-esteem building comments; Positive assessments of the impact of physical activity on the actor.

Adapted from Heaney and Israel (2002).

Measurement may or may not differentiate between the types of aid described above. The same is true with regard to the sources (friends, family, coworkers, etc.) of that aid. Recent research on social support for physical activity suggests that *general* measures of social support (scales with types and sources combined into a single measure) are almost always associated with physical activity behavior at the *bivariate* level (Marshall & Biddle, 2001; Trost et al., 2002; Fahrenwald et al., 2003; Plotnikoff et al., 2001) and are commonly found to be *independently* associated with physical activity, even when psychological mediators are included in the model (Kim et al., 2006; Marquez et al., 2006; Cardinal et al., 2003; Miller et al., 2002; Courneya et al., 2000; and Sternfeld et al., 1999).

There is mixed evidence regarding associations between the specific types of social support and physical activity behavior. Instrumental support is commonly measured in terms of companionship for exercise. Four studies that employed this construct and were reviewed for this paper reported positive associations between

companionship and physical activity (Chogahara, 1999; Booth et al., 2000; and Giles-Corti and Donovan, 2002; Okun et al., 2003). Okun and associates (2003) found that companionship was correlated with total leisure time activity, but it was not independently associated with measures other than the level of strenuous exercise that was reported. It was negatively and independently associated with strenuous physical activity, a finding that may be best explained by the relative independence of those participating in strenuous physical activity at higher levels as they had become habituated to exercise and were less in need of companionship than those who were in earlier stages of change for more intense activity.

Appraisal social support was found to be independently and positively associated with physical activity in two studies (Chogahara, 1999; Okun, et al., 2003) and associated with physical activity at the bivariate level in one study (Booth, et al., 2000). Emotional social support constructed as encouragement was analyzed as a factor in only two studies and was found to be positively associated with physical activity in both cases (Lian et al., 1999; Phongsavan, McLean, & Bauman, 2007). On the other hand, neither study assessed the independence of the relationship in the presence of psychological mediators. It is also worth noting that the latter finding was true for women and not men. Informational social support was found to be weakly correlated ($r=.20$, $p < .001$) with total leisure time exercise by Okun and associates (2003), but not independently associated with physical activity measures. Chogaharra (1999) found that informational support was not independently associated with leisure time activity in an analysis that did not include psychological mediators. Hence, informational support appears to have the weakest of all

evidence of association, although the infrequency of its analysis as a separate form of support raises questions about any strong conclusions in this regard. It may well be true that the various forms of social support have their greatest positive impact at different points in a person's development of a physical activity habit. This suspicion argues for a moderational analysis that could explore differences between groups defined by personal characteristics. From an exploratory perspective, it is reasonable to argue for the measurement of emotional, appraisal, and instrumental social support. Figure 4.1 summarizes the types of interpersonal influence discussed in this review.

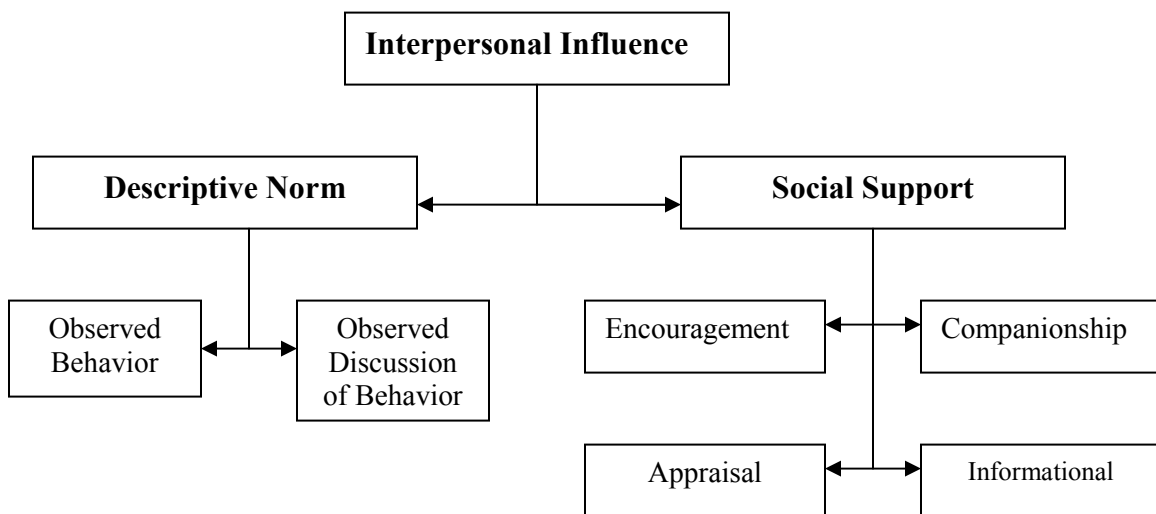


Figure 4.1. Types of interpersonal influence

Interpersonal influence can also be differentiated in terms of its sources. Typically, distinctions are made between friends and family. This approach overlooks to some extent the influence of the occupational context. Although people do work with family and friends, they may not consider their co-workers to be significant others. Nonetheless, workers may spend large amounts of time and receive large amounts of

information from their co-workers, which may shape their behaviors. Accordingly, it seems reasonable that the occupational social context should be included in analyses of interpersonal influence. In fact, there are at least three separate (for the most part) social contexts that should be included in such analyses: home, friendship, and occupational. Each of these contexts is differentiable to some extent for adults.

Taken as a whole, an assessment of social influence on physical activity should contain (at least) the cells depicted in table 4.2:

Table 4.2. Combinations of types and sources of interpersonal influence.

Type ► Source ▼	Observed Behaviors	Observed Speech	Encouragement Social Support	Companionship Social Support	Information Social Support	Appraisal Social Support
Occupational Social Context	Physical activity levels of co-workers	Co-workers' discussions of physical activity	Encouragement from co-workers to participate in physical activity	Co-workers exercising with subject	Co-workers explaining how to manage regular physical activity	Co-workers giving positive feedback on effects of physical activity
Home Social Context	Physical activity levels of Co-habitants	Co-habitants' discussions of physical activity	Encouragement from co-habitants to participate in physical activity	Co-habitants exercising with subject	Co-habitants explaining how to manage regular physical activity	Co-habitants giving positive feedback on effects of physical activity
Friend Social Context	Physical activity levels of Friends	Friends discussions of physical activity	Encouragement from Friends to participate in physical activity	Friends exercising with subject	Friends explaining how to manage regular physical activity	Friends giving positive feedback on effects of physical activity

Given this starting point, it is possible to develop a set of measures to assess interpersonal influence. A separate problem involves the modeling of such measures. Different modeling approaches will yield different patterns of association. From an intervention perspective, it would be useful to know both the context in which to intervene as well as the types of enabling factors to be impacted. This study explores

three approaches to modeling interpersonal influence in an attempt to develop a measurement tool that can be used to explore the associations between people's experiences of their social worlds, on one hand, and physical activity and its psychological determinants, on the other. Such a tool may be used to determine both the social contexts and enabling interpersonal factors to be targeted in physical activity interventions.

Study Aim

The aim of this study was to identify an internally consistent and valid (convergent and discriminant) approach to the measurement and modeling of interpersonal influence on physical activity.

Methods

Sample

Data come from a pre-post employee survey performed at a major healthcare provider in the Southwest United States prior to a initiation of a worksite health promotion program. Participants were recruited through intranet emails and were promised a chance to win an Ipod if they completed both pre and post program surveys. Over 1,240 responses were received, with 1,224 (14.9% of the workforce) providing usable data. Respondents were predominantly female (84.7%) and white (77.4%). A majority were younger than 45 years of age (62.3%), had at least a four year college degree (51.4%), and were not obese based on a self-reported BMI of 30 or greater (62.4%). The sample did not differ significantly from the worksite population in terms of

gender, age, or race/ethnicity. Body composition and educational attainment data were not available for workers not participating in the study.

The sample was divided into a calibration sample and a validation sample on the basis of random assignment. Neither the calibration nor the validation sample varied significantly from the total sample in terms of any personal characteristics.

Measures

Social support and descriptive norm were assessed across three social contexts – occupational, home, and friend. For each of these contexts, respondents were presented with a series of forced choice Likert-type questions, each with four response levels and anchored by Strongly Disagree (=1) and Strongly Agree (=4). Social support items employed in this study addressed encouragement to be physically active and companionship for physical activity, but did not address appraisal or informational support. The descriptive norm items assessed the respondents' perceptions of others' discussion of and participation in regular physical activity. Table 4.3 lists the items used to evaluate the descriptive norm and social support with their means, standard deviations, and number of usable responses in the calibration sample.

Table 4.3. Items used to evaluate the descriptive norm and social support across three social contexts.

Construct Assessed	Item	Mean¹ (SD)
Social Support	1. My co-workers encourage me to participate in moderate or vigorous physical activity.	2.24 (.94)
	2. I participate in moderate or vigorous physical activity with a co-worker.	1.74 (.89)
	3. The people I live with encourage me to participate in moderate or vigorous physical activity.	2.71 (.99)
	4. I participate in physical activity with a person from my home.	2.32 (1.05)
	5. My friends encourage me to participate in moderate or vigorous physical activity.	2.41 (.94)
	6. I participate in physical activity with one or more of my friends.	2.13 (.99)
Descriptive Norm	1. My co-workers talk about being physically active.	2.73 (.95)
	2. My co-workers often participate in moderate or vigorous physical activity.	2.47 (.89)
	3. The people I live with talk about being physically active.	2.73 (.95)
	4. The people I live with often participate in moderate or vigorous physical activity.	2.51 (1.00)
	5. My friends talk about being physically active	2.61 (.88)
	6. My friends often participate in moderate or vigorous physical activity.	2.41 (.90)

1. Calibration sample values.

Analysis

The analysis was composed of two stages – model selection and model development. In the first step, confirmatory factor analysis was employed to compare three approaches to modeling interpersonal influence – a one factor model called the Interpersonal Influence model, a two factor model based on social support and descriptive norm factors and called the Type of Influence model, and a three factor model based on work, home, and friend interpersonal environments called the Social Context model. Baseline models were estimated with all indicators being determined only by a single factor and an error term. Figures 4.2, 4.3, and 4.4 present the three baseline models evaluated using the calibration sample data. Raw data were subjected to a cubic transformation to adjust for non-normality. Mplus 5.1 (Muthen & Muthen, 2007) was used for maximum likelihood estimation. The best fitting model was selected for further development.

Model fit was judged on the basis of model/degrees of freedom, CFI, (Aikake Information Criterion) AIC, RMSEA, and SRMR. Where sample size is large, Kline (2005) recommends using the model χ^2 /degrees of freedom ratio as an indicator of model fit and suggests that values of 3.0 or less are deemed acceptable. The Comparative Fit Index (CFI) provides an incremental measure of model fit based on a comparison to a null model in which no variables are correlated. Values of .90 and above are considered acceptable for this index (Kline, 2005). The AIC is a parsimony adjusted measure that is useful in the comparison of non-hierarchical models, such as is the case in this study

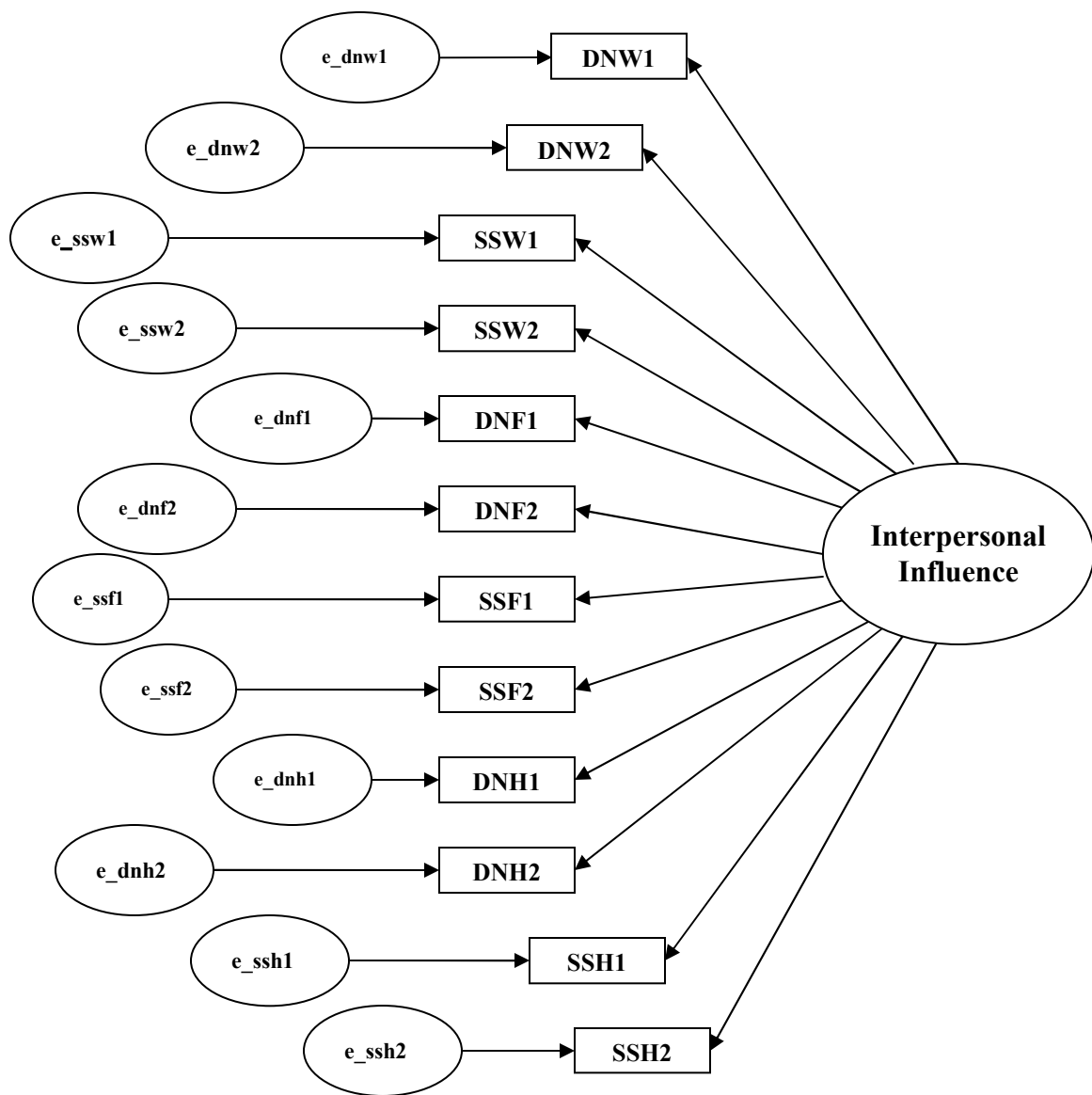


Figure 4.2. The baseline Generalized Model of Interpersonal Influence

DN	Descriptive Norm
SS	Social Support
W	Work Context
H	Home Context
F	Friend Context
e_	error term for that indicator

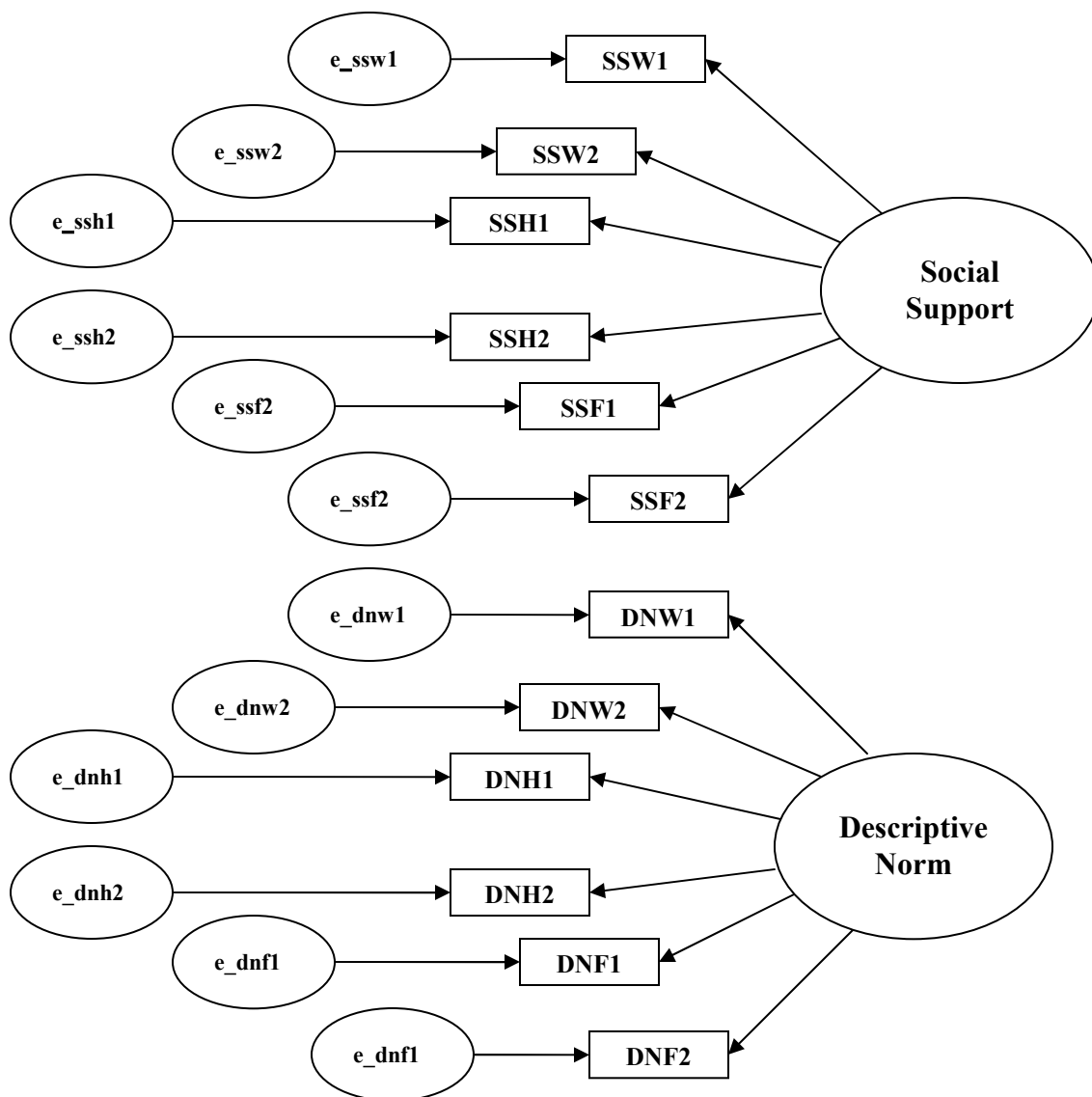


Figure 4.3. The baseline Type of Influence Model of Interpersonal Influence (two factor model)

DN	Descriptive Norm
SS	Social Support
W	Work Context
H	Home Context
F	Friend Context
e_	error term for that indicator

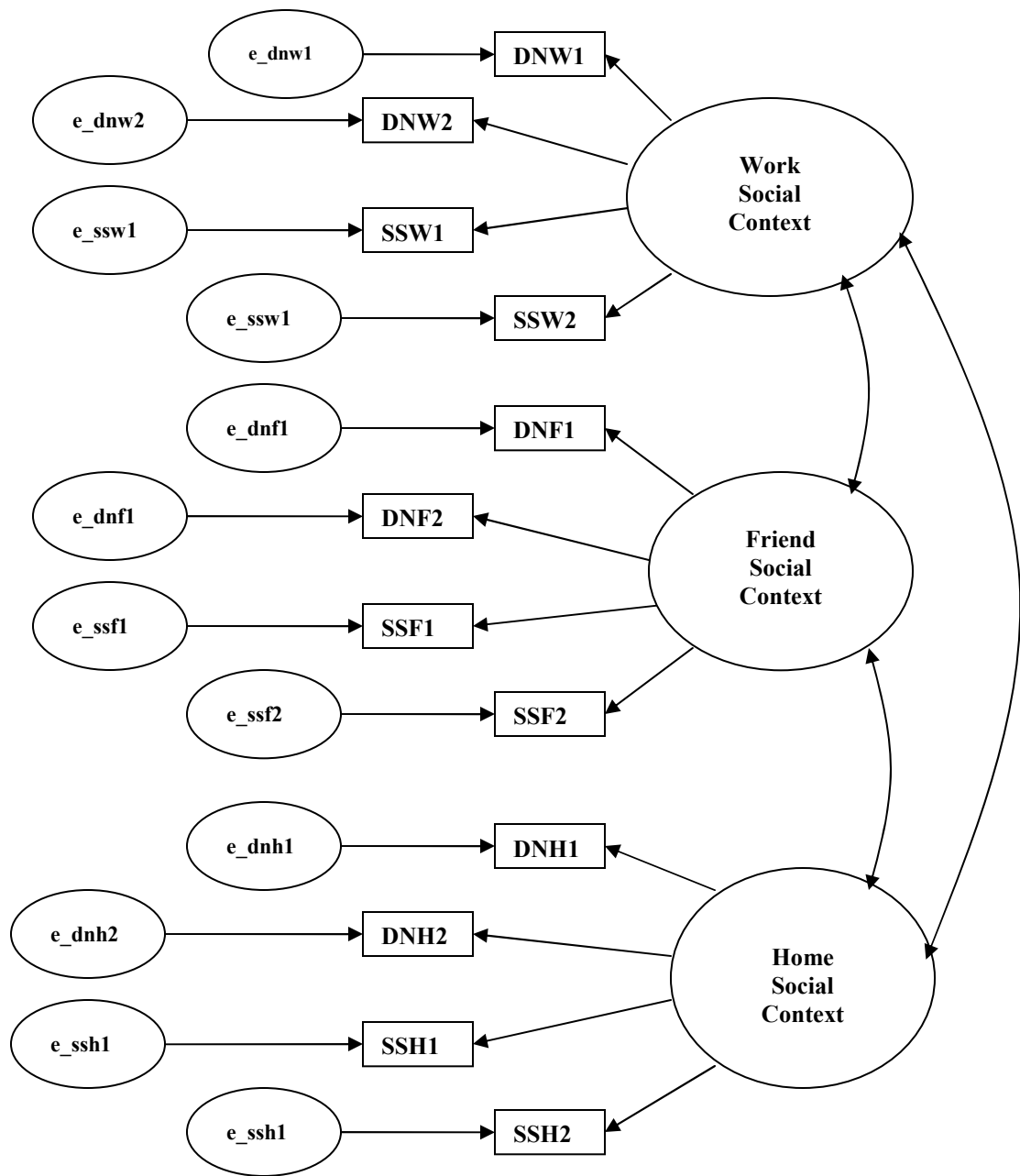


Figure 4.4 The baseline Social Context Model of Interpersonal Influence (three factor model)

DN Descriptive Norm
 SS Social Support
 W Work Context
 H Home Context
 F Friend Context
 e_ error term for that indicator

(Kline, 2005; Wang & Liu, 2006). The smaller value in a comparison of AIC values is considered representative of a better fitting model. The Root Mean Square Error of Approximation (RMSEA) provides for estimates of good model fit and is more appropriate to over-identified models than procedures comparing models to a standard of perfect fit. Point estimates, 90% confidence intervals, and a probability of good model fit are provided in output by Mplus. Null hypothesis rejection is judged on the confidence intervals, although all statistics are commonly reported. Values of 0.05 and below are indicative of good model fit, between 0.05 and 0.08 indicate acceptable fit, and those equal to or greater than 0.10 are considered indicative of poor fit (Kline, 2005; Browne and Cudeck, 1993). The Standardized Root Mean Square Residual provides an estimate of the mean correlation residual, which is understood to be the difference between the correlations that are predicted and observed (Kline, 2005). Values of less than 0.10 are considered indicative of good fit.

Convergent validity in a factor model was judged on the basis of the magnitude of the factor loadings, compared item by item across models (Kline, 2005). Loading of greater magnitude provide evidence that the indicators are more strongly associated with the factor being studied. Discriminant validity is based on the magnitude of correlations between factors. Correlations above 0.85 are indicative of collinearity between factors rather than differentiability (DeVellis, 2003). Explained variance, as noted by DeVellis (2003), is an important consideration in developing scales with predictive validity. Higher levels of explained variance in a scale suggest the potential for greater predictive validity, all other factors being equal. The internal consistency of the scales associated

with each of the three models tested was assessed in terms of Cronbach's alpha as computed by SPSS 16.0 (reference). Values of .70 and above are considered a minimum standard for the internal consistency of most scales (DeVellis, 2003).

Model development and replication

Two types of changes to the model arose out of the development process. The item assessing co-worker participation in physical activity was modeled as an indicator for both friend and work social contexts. This is consistent with the results of a preliminary exploratory factor analysis that found this item loaded onto both of these factors and with the expectation that the influence of the factor friend social context might overlap with both work and home contexts for many respondents.

Assuming a significant modification index value, error correlation was allowed for items that could be subject to response set, such as those which were consecutive in their presentation in the survey and for those of similar type such as social support items or descriptive norm items from different social contexts. Non-significant error correlation paths were trimmed on the basis of negative model χ^2 difference test results. The last step in the analysis involved fitting the final confirmatory factor model with all modifications to the validation sample for purposes of replication.

Results

One (Interpersonal Influence), two (Type of Influence), and three (Social Context) factor confirmatory baseline models were estimated. Only the social context baseline model approached (but did not reach convincingly) acceptable fit. The model χ^2/df ratio

of the Social Context Model (10.1) is larger than the 3.0 value recommended by Kline (2005), but it is less than half of magnitude of the ratios from the one factor (24.6) and two factor (24.3) models. While none of the models have an acceptable value for the CFI, the value for the Social Context Model approached the .90 standard (0.87), while the Interpersonal Influence and Type of Influence Models had CFI values of 0.62 and 0.63, respectively. The AIC is used to compare non hierarchical models and was clearly more favorable for the Social Context model (61562 vs. greater than 62,300 for the Interpersonal Influence and Type of Influence models). The RMSEA for the Social Context Model was 60% of the other models (0.12 vs. 0.20), although all models demonstrated poor fit. Finally, the SRMR for the Social Context Model was within acceptable limits for a good fitting model (0.07), the other models had values approximately 50% larger and were in excess of the 0.10 standard (0.11 in both cases).

The convergent validity of the Social Context Model exceeded that of the Interpersonal Influence and Type of Influence Models. Of the 12 indicators in the three models, the largest loadings for nine of them were found in the Social Context Model. The loadings for the other indicator (companionship with a friend for physical activity) were virtually the same for the Social Context Model (.64) as the magnitude of the largest loading coming from the Type of Influence Model (.67).

The discriminant validity of the Social Context Model was superior to that of the Type of Influence Model. The standardized correlation between the social support and descriptive norm factors was 0.90, in excess of the standard of 0.85. For the Social Context Model the correlations were sizeable, but more modest, with the largest being

0.63 between the home and friend social contexts, followed next by the correlation between the friend and worksite contexts (0.56), and followed last of all by the worksite and home context correlation of 0.38.

The Social Context Model explained more variance for nine of the twelve indicators than did either of the other two models. Although all models explained comparable levels of variance for the items associated with the friend social context, the social context model explained 1.1 to 2.4 times as much variance for the other indicators. Finally, all factors associated with the social context model displayed acceptable levels of internal consistency. The Cronbach alpha values for the factors ranged from 0.78 for the work context to 0.84 for the home context and 0.85 for the friend context. The results of all foregoing analyses are presented in Table 4.4.

Table 4.4. Summary of tests of model fit, convergent and discriminant validity, explained variance, and scale internal consistency on the calibration sample.

Model	Statistics	Interpersonal Influence Model	Type of Influence Model	Social Context Model
Baseline				
	Model χ^2/df	24.6	24.3	10.1
	CFI	0.63	0.65	0.87
	AIC	18794.81	62335.102	61562.534
	RMSEA	.20 (.19-.21)	.20 (0.19-0.21)	.12 (.11-.13)
	SRMR	.11	0.11	.07
Factor Loadings		A	B	C
	DNW1	0.50	0.50	0.78 ^d
	DNW2	0.48	0.48	0.79 ^d
	SSW1	0.51	0.52	0.75 ^d
	SSW2	0.40	0.43 ^d	0.38
	DNH1	0.57	0.56	0.80 ^d
	DNH2	0.62	0.62	0.83 ^d
	SSH1	0.64	0.64	0.73 ^d
	SSH2	0.58	0.59	0.63 ^d
	DNF1	0.76	0.80	0.82 ^d
	DNF2	0.76	0.79	0.83 ^d
	SSF1	0.73	0.76 ^d	0.75
	SSF2	0.63	0.67 ^d	0.64
R²				
	DNW1	.25	.25	.61 ^e
	DNW2	.23	.23	.62 ^e
	SSW1	.26	.27	.56 ^e
	SSW2	.16	.19 ^e	.14
	DNH1	.32	.31	.64 ^e
	DNH2	.38	.38	.69 ^e
	SSH1	.34	.41	.53 ^e
	SSH2	.30	.35	.40 ^e
	DNF1	.62	.64	.67 ^e
	DNF2	.62	.62	.69 ^e
	SSF1	.53	.58 ^e	.56
	SSF2	.40	.45 ^e	.41
Internal Consistency (α)				
	Interpersonal Influence	.87		
	Descriptive Norm		.79	
	Social Support		.78	
	Worksite Environment			.78
	Home Environment			.84
	Friend Environment			.85

a. all indicators load on Social Influence factor

b. DN indicators load on Descriptive Norm factor and SS indicators load on Social Support factor.

c. W indicators load on Work context factor, H indicators load on the Home Context factor, and F indicators load on the Friend Context factor.

d. Greatest magnitude loading value for a given item

e. Greatest magnitude R² value for a given item

Model Development

Based on its superior values for the baseline model, the Social Context Model was selected for respecification conditional on either response set (for error covariances) or factor cross-loading and significant modification index values. The covariances of sixteen pairs of error terms were estimated because of potential for response set. Eleven pairs were estimated based on the measurement similarity of items assessing either social support or descriptive norm. Error covariances were also estimated for five pairs of error terms for items that were adjacent in survey presentation. Two error covariance paths were trimmed based on insignificant path values and a negative model χ^2 difference test. Four error covariance paths were trimmed because of negative values.

The potential for overlap between the friend social context and the other contexts led to the inspection of paths for potential crossloading; the addition of a path from the friend social context factors to the worksite companion for physical activity item contributed significantly to the fit of the model. The resulting model with ten covaried error terms proved to be a good fit to data, although the model χ^2/df ratio of 4.3 exceeded the standard of 3.0. The CFI value was greatly improved at 0.96. The RMSEA estimate was indicative of acceptable fit (0.07) on the basis of the 90% confidence interval (0.06 - 0.09). The SRMR value of 0.03 was well inside of the acceptable range (less than 0.10).

Replication

The Social Context Model was next analyzed for estimation on the validation sample for purposes of replication. Model fit statistics were superior to those from the calibration sample and indicative of good or acceptable fit of the model to the data. The

model χ^2 /degrees of freedom ratio was 2.5. The RMSEA estimate was .05 with a confidence interval of .04 - .06 and the probability of the model being a good fit was .48. The CFI was .99 and the SRMR was .03.

Factor loadings and explained variance results for the model estimated on the validation sample were also similar to those of the model run on the calibration sample with the exception of the association between physical activity companionship with co-workers and both the friend and work social contexts. The loading on the friend social context factor was much stronger in the calibration sample (.25 vs. .12). The loading on the work social context factor was much stronger in the validation sample (.40 vs. .17). The amounts of explained variance were similar for the two models, as well, although R^2 estimates for seven of the twelve items varied by more than 10% between the samples. Table 4.5 presents the fit statistics for the final models estimated on the calibration and validation samples. Figure 4.5 presents the results of final model estimation on the calibration and validation samples.

Table 4.5. Fit statistics for the final model.

	Calibration Sample	Validation Sample
Model χ^2/df	4.3	2.4
CFI	.96	.99
RMSEA	.07 (.06-.09)	.05 (.04-.06)
SRMR	0.03	.03

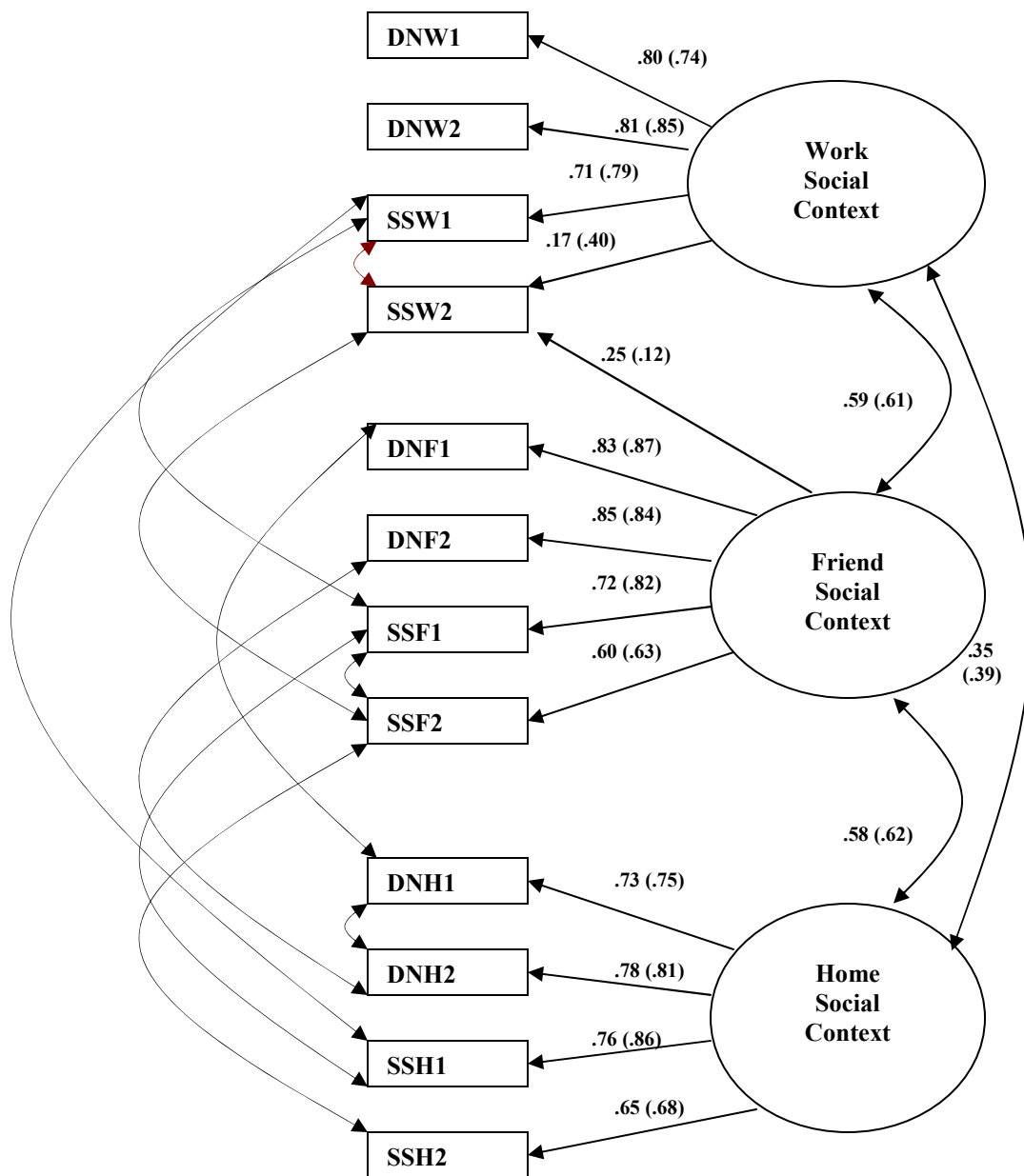


Figure 4.5. Comparison of calibration and validation sample estimates*

DN Descriptive Norm
 SS Social Support
 W Work Context
 H Home Context
 F Friend Context
 e_ error term for that indicator

*Error correlations implied by arrows for ease of interpretation.

The internal consistency of the work, home, and friend social contexts was estimated for the validation sample. The Chronbach's alpha value for the work social context factor was 0.78 (compared with 0.83 on the calibration sample), the home social context factor was 0.84 (compared with 0.85 on the calibration sample), and the friend social context was 0.85 (compared with 0.87 on the calibration sample). These values all exceed the minimum value of 0.70.

Discussion

The results of model comparison, generalizability of results, and implications for research and practice are addressed in turn.

Model Comparison

The Social Context Model of interpersonal influence was found to provide the best fit to data of all models considered in this study. While three of the fit statistics (CFI, RMSEA and model χ^2 /degrees of freedom) for baseline models were below accepted standards for good fit, the SRMR of the Social Context model were within the acceptable range. All fit statistics favored the Social Context Model over the Type of Influence and General Model of Interpersonal Influence. The superior fit reflects the larger magnitude of correlation among indicators of the interpersonal influence factors employed in the Social Context Model than in the other models.

The Social Context Model offered the highest degree of convergent validity of all models considered. The magnitudes of the factor loadings were suggestive of convergence with the exception of the items assessing the participation in physical

activity with co-workers, cohabitants, and friends. All of these loadings were below .70 which means that less than half of the variance in the indicator is explained by its association with a social context factor. This finding is easily understood given the low levels of physical activity reported by study respondents.

The study results suggest that social contexts are differentiable in terms of the extent to which people talk about their physical activity, provide evidence for same, and even encourage others to do so. On the other hand, many respondents in this study report little or no physical activity. The companionship for activity indicator requires the respondent to participate in physical activity while the other indicators do not. It is, therefore, not surprising that the companionship indicator does not load as heavily on this factor because responses to it are caused by another factor not measured here - participation in physical activity.

Two conclusions can be drawn from this. A social context model used to predict physical activity may perform better if it includes the companionship indicator. More importantly, perhaps, companionship ought to be considered as a personal resource that facilitates physical activity rather than in the same category as other forms of social support which derive from the exchange of verbal information, such as encouragement or information social support. A further consideration along these lines might be the differential association of various types of social support across different stages of change.

The discriminant validity of the Social Context Model was also superior to that of the other models. This finding leads to the conclusion that a social context describes a

generalized pattern of influence that is perceived by the individual. The high level of correlation between descriptive norm and social support emphasizes the similarity in sources of support across different types of influence. In short, different types of influence *within* a social setting are more alike than are the same types of influence from *different* social settings.

The Social Context Model explained the most variance in the indicators of all of the models. In general, the Social Context Model did explain acceptable levels of variance in all social contexts, although, as discussed above, the items assessing participation in physical activity with a co-worker were the least well explained in each context.

Taken as a whole, the results of baseline model comparisons suggests that people experience more consistency in the social contexts in which they operate than in terms of types of influence that cut across these contexts. The superior convergent validity of the Social Context Model makes this point explicitly. The failure of the Type of Influence Model to achieve discriminant validity further demonstrates the power of social context as an organizing concept in the perception of interpersonal experiences. When the social support and descriptive norm items from the same social context were located in different factors, the factors were found to be highly correlated and, thus, not capable of differentiating between types of social influence. Not surprisingly, the Type of Influence Model represented little improvement over the one factor model.

The scales derived from the indicators of each social context factor all exhibited acceptable levels of internal consistency, further documenting the strong patterns of

association among items associated with the three social contexts assessed. This finding confirms the potential utility of these factors in future regression analysis, as was suggested by the relatively high levels of explained variance associated with each item.

Generalizability and Limitations

Although generalizable to the worksite population, the results of the study are subject to several limitations. The most fundamental constraint on data interpretation is its self-report nature in the absence of equiprobability sampling. All data in this study were obtained via self-report questionnaire. As such they are subject to distortions from response desirability and response set. Furthermore, these data were collected at the worksite, a consideration that raises the issue of enhanced response desirability, although guaranteed anonymity may have helped to overcome this to some extent. It is also worth noting that although some variables in this data set show little variability due to a ceiling effect, other items assessing worksite climate and supervisor behavior (not presented here) reflect considerable variation. The observed variability in these sensitive items argues for less social desirability impact on responses.

The failure to include items assessing appraisal and informational social support calls into question the predictive validity of the measures developed here, a concern to be addressed in future research. The impact of this source of unobserved variance is not clear in terms of the present study. If the pattern of stronger associations within social context than within type of influence holds, the Social Context Model will continue to be the best performing model, even when indicators for these constructs are added.

Implications for further study

This study suggests a number of ideas for research and practice. From an application perspective, the social context approach to assessing interpersonal influence that is presented in this work does provide the basis for an analysis of the relative impacts of social contexts on physical activity behavior and its determinants. It does not provide for an *impact analysis of the type of influence within contexts*. This could be accomplished through multiple regression analysis utilizing the individual items assessing types of influence, as is commonly employed in the literature.

From a theoretical perspective, the recognition of social contexts as organizing concepts in people's perceptions of their social world supports an argument for a different take on the measurement and modeling of behavioral determinants. It is suggested here that while it is not completely unlike other self-regulatory approaches, a perception control model (Powers, 1973) lends itself to the development of theoretical and analytical paradigms which could lead to a more elaborated and generalizable understanding of the role of the social environment in shaping individual behavior. Understanding actors in terms of their efforts and abilities to control their perceptions of their various social environments could change the understanding of physical activity behavior both as a form of action and with regard to its determination. Carver (1998) and Carver and Scheier (1998) have explored a perception control model in a health promotion/resilience context and this deserves more serious consideration and thoughtful elaboration.

Considering the limitations on the measurement approach employed here (number and content of items, self-report, online data collection), this paper suggests a framework for developing more comprehensive measurement approaches, both survey and otherwise. It is worth noting that a more fine-grained analysis of exchange relationships that takes into account power balances in relations could provide more accurate estimates of interpersonal influence. It is the hope of the author that improved measurement and modeling of interpersonal influence on physical activity will lead to interventions that are more precisely targeted for social context and behavioral determinants, leading to noticeable improvement in intervention outcomes and public health.

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CHAPTER 5

MEDIATION AND MODERATION OF INTERPERSONAL INFLUENCE ON INTENTION TO PARTICIPATE IN PHYSICAL ACTIVITY¹

Introduction

By way of explaining the importance of behavioral intention and how it can be influenced, Martin Fishbein¹ noted that

In contrast, if a person has not yet formed a strong intention to perform a given behavior, the goal of the intervention should be to strengthen the person's intention to perform that behavior. This could be accomplished by changing self-efficacy, outcome expectancies (or attitudes), norms, self-standards, or emotions vis-à-vis that behavior. The issue then becomes choosing which variable to target in the intervention. (1995:252)

The next question becomes “How do I influence the variables which might lead to increasing intention?” This question decomposes into separate issues such as setting, media channel, and message or approach. This study seeks to explore the potential for impact on self-efficacy, anticipated outcomes (an analogue of outcome expectancies), and intention through interpersonal influence. It does so by assessing multiple social contexts for their potential to serve as conduits for influence that will impact behavioral determinants, including intention. This approach takes issue with two aspects of the NIMH conference statement and the Integrated Behavioral Model² which gives a more formal structure to the findings of the conference. The first is the impact of social support on physical activity behavior, which is not represented in either model, yet is well supported in the literature. The second regards the placement of the social norm as

causally prior to self-efficacy and anticipated outcomes, rather than the contemporaneous causal position it holds in the IBM.

Research on Behavioral Determinants

Research has consistently found independent associations between self-efficacy for physical activity and intention to participate in it.³⁻¹⁵ The same can be said for anticipated outcomes and intention.^{4-6,9,11,13,14,16} Social support has been found to be associated with intention more often than not.^{6,9,14,15} It has also been found to be associated with self-efficacy^{6,9,13-15} and anticipated outcomes^{6,9,14,15}

The descriptive norm has been given much less attention until recently. It was found to be positively and independently associated with intention in three out of four studies reviewed for this research.^{5,17,18} Okun and associates^{5,6} found correlations between the descriptive norm and both perceived behavioral control for leisure time exercise and attitudes toward physical activity in two studies.

Study Aims

This study will test the assertions that social context factors are associated with intention and are completely mediated by self-efficacy, positive anticipated outcomes, and negative anticipated outcomes. The study will also assess whether the patterns of mediation found through structural equation modeling are moderated by three personal characteristics associated with differences in physical activity behavior – age, body composition, and educational attainment. Measurement, theoretical, and applied implications will be drawn from the results. Figure 5.1 presents the model to be tested.

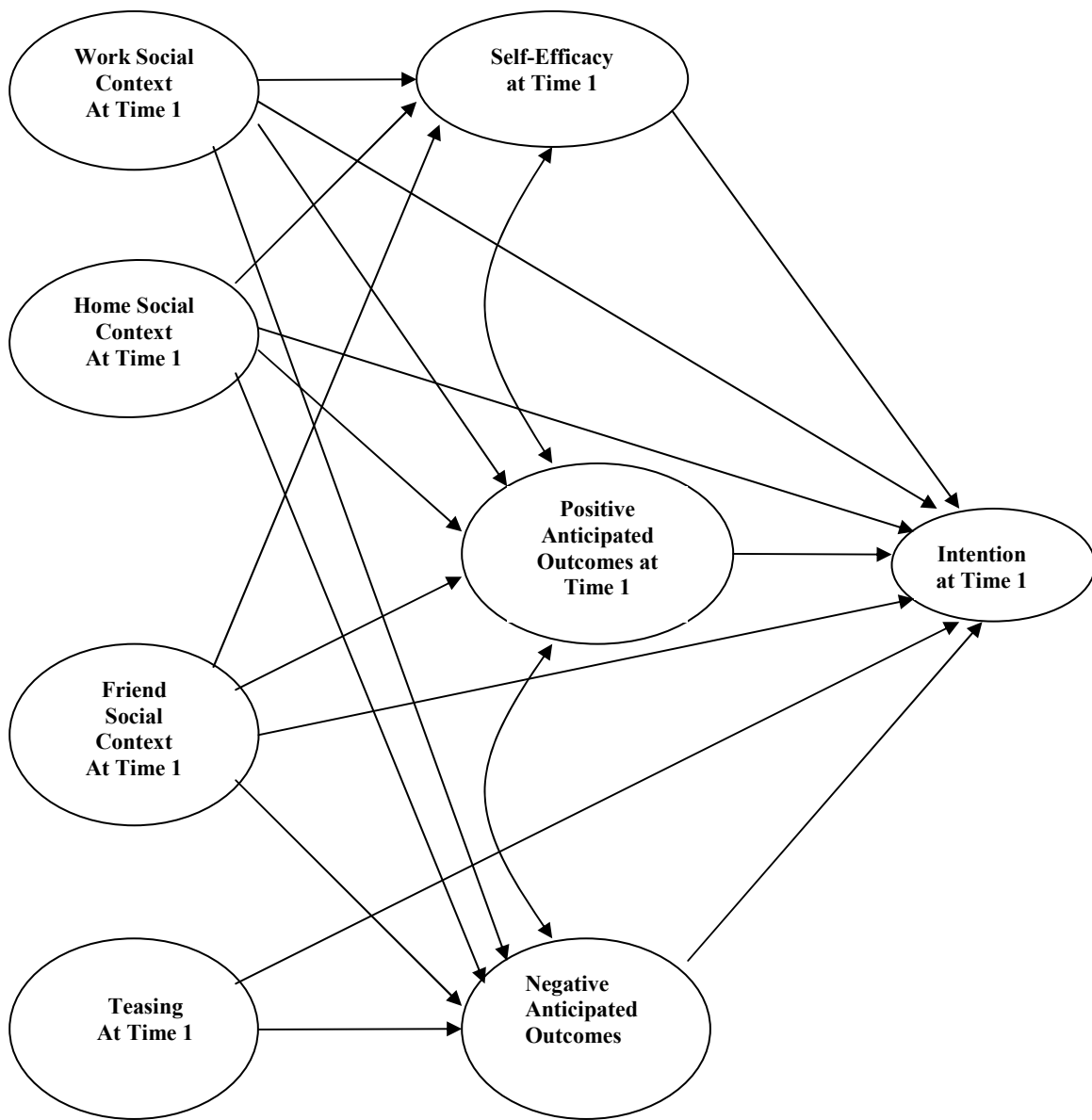


Figure 5.1. The Social Context Model of Interpersonal Influence on Intention to Participate in Physical Activity

Methods

Sample

Data come from an employee wellness program evaluation performed at a major healthcare provider in the southwest prior to a worksite health promotion initiative. Subjects were recruited through intranet emails and were promised a chance to win an iPod if they completed both pre and post program surveys. Over 1,240 responses were received, with 1,224 providing usable data. Respondents were predominantly female (84.7%) and white (77.4%), A majority were younger than 45 years of age (62.3%), had at least a four year college degree (51.4%), and were not obese (62.4%).

The sample was divided into calibration (n=612) and validation samples (n=612) by random assignment. Neither the calibration nor the validation sample varied significantly from the total sample in terms of any personal characteristics. The samples were similar to the worksite population from which they were drawn with regard to age, gender, and ethnicity. Information on educational attainment and body composition was not available on the entire worksite population.

Measures

Social support and descriptive norm were assessed across three social contexts – occupational, home, and friend. For each of these contexts, respondents were presented with a series of forced choice Likert type questions, each with four response levels and anchored by Strongly Disagree (=1) and Strongly Agree (=4). Social support items employed in these data addressed encouragement by others to be physically active and companionship for physical activity. The descriptive norm items assessed the

respondents' perceptions of others' discussion of and participation in regular physical activity. Three items assessed teasing about not being athletic by associates, one in each of the social contexts. The response patterns were like those of other social context items.

The survey included three items assessing behavioral intention, two expressed positively as intention and one negatively as expectation.¹⁹ The questions were prompted with the heading "Your plans for Spring" and were anchored by the evaluations "Strongly Disagree" (1) and "Strongly Agree" (5). The items specified both the time period and the frequency and duration of physical activity required.

Self-efficacy was assessed using four items that specified common barriers to physical activity.²⁰ A stem was provided "How confident are you that you could be physically active or exercise when..." and was followed by four items that addressed rain or excessive heat, tiredness, "not much time", and a "tight schedule." Response options varied from 1-5 and were anchored by the expressions "Not at all Confident" and "Extremely Confident."

Anticipated outcomes for physical activity were assessed with six items that consisted of both outcome expectation and outcome expectancy components. Outcome expectancy refers to the value placed on an outcome, whereas the concept outcome expectation refers to the anticipated consequence(s) of behavior.²¹ The expectancy component was expressed in the stem that precedes the question block: "Please rate how important each of these statements is in your decision of whether to be physically active. In each case, think about how you feel right now, *not how you have felt in the past or would like to feel.*" This prompt is followed by a set of four items expressing positive

outcomes (“have more energy,” “feel more relaxed,” etc.) and two expressing negative outcomes (“takes too much time” and “does not enjoy the feeling of exercise”).

Response options represent the importance of the outcomes described in each statement with anchors of “Not at all important” (1) and “Extremely important” (5).

Age was measured by categories with 10 year increments (e.g., 25-34, etc) and their educational levels in terms of highest advancement (no high school, some high school, high school graduate or GED, etc). BMI was computed based on self-reported height and weight. Social context and psychological variables were adjusted for non-normality through a cubic transformation.²² Missing data were adjusted for by the exclusion of eight cases with sufficient missing data to make imputation estimates unstable.

Model Development

The approach employed here is based on Joreskog’s discussion of model development.²³ This approach requires the development of single factors with good fit that are then linked together first as a pair and then as larger sets of factors. In this study, the social context factors were introduced as a set having been developed in a previous study.²⁴ The psychological factors Self-efficacy for Physical Activity, Positive Anticipated Outcomes for Physical Activity, Negative Anticipated Outcomes for Physical Activity, Behavioral Intention for Physical Activity and the negative interpersonal influence factor Teasing were all constructed through confirmatory factor analysis. Those factors which were independently associated with at least one other factor were retained in the final model.

Analysis of Intention Model

The baseline model was fitted to the calibration data set using Mplus 5.1.²⁵ Kline recommends using four factors to determine model fit – model $\chi^2/\text{d.f}$ (for large samples).; Comparative Fit Index (CFI); Root Mean Square Error of Approximation (RMSEA); and Standardized Root Mean Square Residual (SRMR).²² Table 1 summarizes the standards for good model fit associated with each measure. The baseline model was the fitted to the validation sample for replication.

Table 5.1. Summary of recommended fit index values.¹

Fit Index	Recommended Value for Good Fit
Model $\chi^2/\text{d.f}$	3.0 or less
CFI	.90 or greater
RMSEA	.05 or less (judge by confidence interval)
SRMR	Less than .10

1. Kline, 2005

Multigroup models were used to assess moderation by age (<45 years vs. 45 and older); body composition (BMI < 30 vs. 30 and greater); and educational attainment (no 4 year college degree vs. 4 year college degree). Moderation testing involved the computation of a multigroup, baseline model; assessment of single path invariance, and the replication of these findings with a final model in which only paths that were invariant across groups were allowed to vary freely. All moderation protocols were repeated using the validation sample for replication of results.

Results

Descriptive Statistics

The scales were computed as indicator means. Their correlations, means, and standard deviations were computed. Teasing was not correlated with self-efficacy and intention. Negative anticipated outcomes was not correlated with work context. All other computed variable pairs were correlated. Table 5.2 presents the variable means and standard deviations, as well as bivariate correlations from the calibration sample data.

Table 5.2. Bivariate correlations, means, and standard deviations of study variables.¹

Variable	1	2	3	4	5	6	7	8
1. Intention	—							
2. Self-efficacy	.56**	—						
3. Positive Anticipated Outcomes	.37**	.33**	—					
4. Negative Anticipated Outcomes	-.35**	-.26	-.26**	—				
5. Work Social Context	.24**	.24**	.20**	.04	—			
6. Friend Social Context	.35**	.30**	.32**	-.13**	.52**	—		
7. Home Social Context	.33**	.34**	.31**	-.14**	.31**	.53**	—	
8. Teasing	-.05	.04	-.11*	.21**	-.12**	.18**	.10*	—
Mean	3.48	2.79	4.11	2.13	2.30	2.38	2.58	1.39
Standard Deviation	1.13	1.00	.82	1.63	.71	.78	.82	.54

1. Correlations, means, and standard deviations computed on the calibration data set

* Correlation is significant at the .05 level.

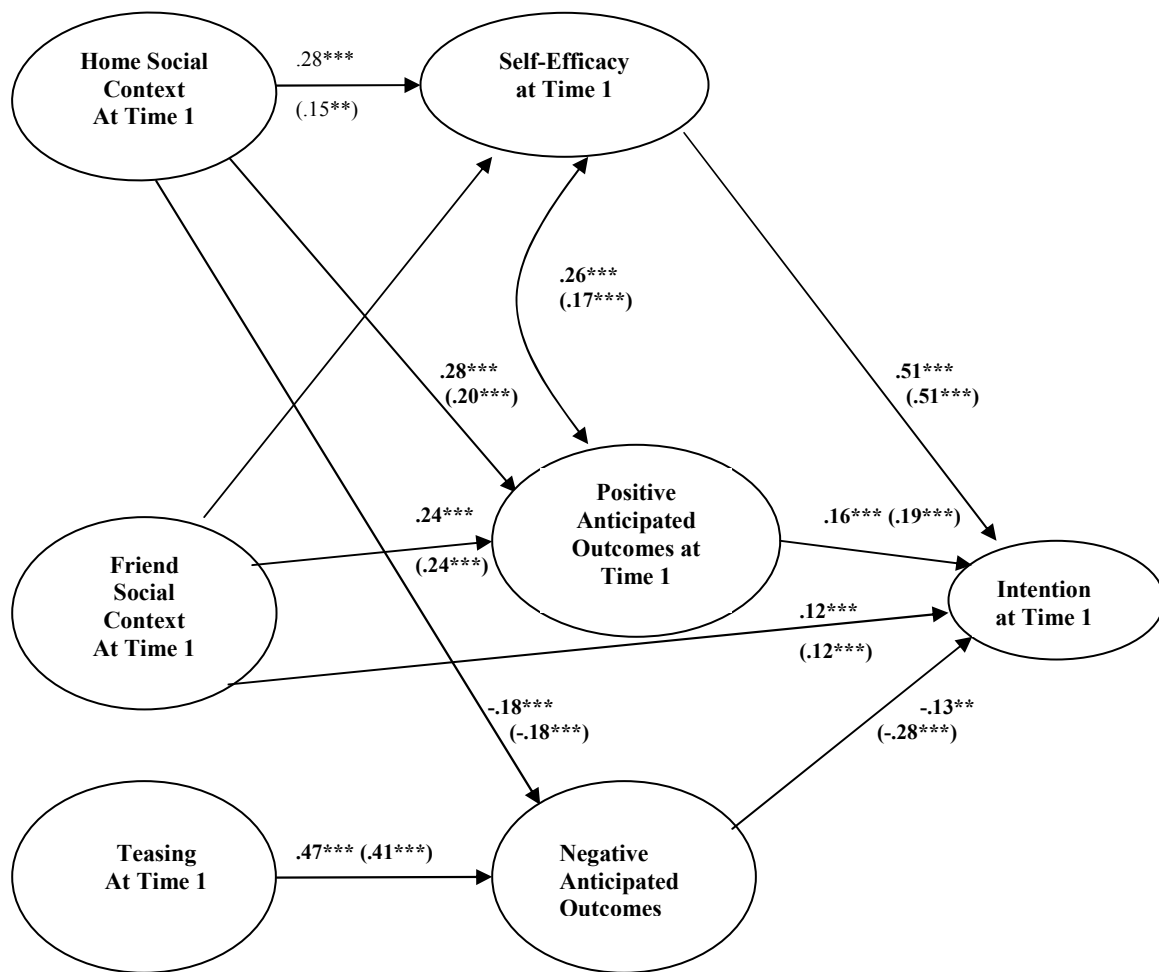
** Correlation is significant at the .01 level.

Model Development

A psychological factor model was constructed with intention regressed on self-efficacy, positive anticipated outcomes and negative anticipated outcomes. Independent associations were identified between intention and all of the other factors. The social context factors developed as a set through confirmatory factor analysis were added with

each social context factor allowed to vary freely with each of the psychological factors to assess mediation. A teasing factor composed of items from each of the three social contexts was also added because of its independent association with negative anticipated outcomes. While this model fit the data acceptably (χ^2 (288, $n=612$) = 721.46, $p < .001$; CFI=.94; RMSEA=.050 (.045-.054), $p=.55$; SRMR=.05), eight paths were not significant. Seven of these paths were trimmed, one at a time, in order of descending p-value until all paths involving endogenous variables were significant.

The resulting model fit the data well (χ^2 (295, $n=612$) = 732.24, $p < .001$; CFI=.94; RMSEA=.049 (.045-.054), $p=.61$; SRMR=.05). It was estimated on the validation sample for purposes of replication. The model fit these data well (see Figure 5.2 below) and all relationships identified in the calibration sample were replicated. Figure 5.2 presents the results of the regression analysis and model fit statistics. All regression coefficients are standardized and those in parentheses represent validation sample results.



Parameter	Calibration Sample Estimates	Validation Sample Estimates
Model χ^2 /d.f.	2.48	1.73
CFI	.94	.96
RMSEA	.049 (.045-.054)	.042 (.037-.047)
SRMR	p=.61 .05	p=1.00 .06
R ² (Standardized)		
Intention	.45	.51
Self-efficacy	.16	.16
Positive Anticipated Outcomes	.23	.15
Negative Anticipated Outcomes	.24	.18

Figure 5.2. Fit statistics and regression results from estimation of the baseline model on the calibration and validation¹ samples.

1. Validation sample regression coefficients in parentheses.

Moderation Testing

Moderation testing revealed several significant differences on some relationships for age, body composition, and educational attainment. The covariance of the disturbance terms of self-efficacy and anticipated outcomes were found to vary by age. The correlation (standardized result) between the disturbance terms for self-efficacy and anticipated outcomes was not found for the younger respondents, but did exist for the older members of the calibration sample ($r=.33$, $p < .001$). This difference was replicated on the validation sample; the association was significant ($r=.15$, $p < .05$) for younger respondents, but of greater magnitude for the older ones ($r=.42$, $p < .001$).

The association between teasing and negative anticipated outcomes was found to vary by age in the calibration sample. Younger respondents reported a significant, positive association ($b=.67$, $p < .001$), while the association was weaker for older respondents ($b=.38$, $p < .001$). No significant difference was detected between younger and older respondents in the validation sample analysis.

While no differences in patterns of association were found between obese and non-obese respondents in the calibration sample analysis, two significant patterns of difference were found in the analysis of the validation sample. Friend social context was more strongly associated with anticipated outcomes for obese respondents ($b=.33$, $p < .001$) than for non-obese respondents ($b=.17$, $p < .05$). Friend social context was independently associated with intention for obese respondents ($b=.16$, $p < .001$), but not for non-obese respondents.

Calibration sample analysis found that there were three patterns of association that varied significantly by educational level and one association that was marginally different ($\Delta\chi^2 = 3.67$). The association between self-efficacy and intention was greater in magnitude for those with a four year college degree ($b=.58, p < .001$) than for those without ($b=.46, p < .001$). This result was replicated on the validation sample. The association between home social context and self-efficacy was greater in magnitude for those with a four year degree ($b=.35, p < .001$) than for those without ($b=.20, p < .05$). This finding was replicated on the validation sample. Finally, the association between teasing and negative anticipated outcomes was larger in magnitude for those without a four year degree ($b=.57, p < .001$) than for those with a four year degree ($b=.29, p < .001$). Table 5.3 summarizes the relationships that were associated with the moderating variables.

Table 5.3. Moderating associations between personal characteristics and mediational patterns.^{1,2,3}

Moderator	Relationship	Calibration Sample Category 1 Younger than 45 years	Calibration Sample Category 2 45 Years and older	Validation Sample Category 1 ¹ Younger than 45	Validation Sample Category 2 ¹ 45 Years and older
Age	Anticipated Outcomes ¹ ↔	NS	.33***	.15*	.42***
	Self-Efficacy Teasing ² →	.67***	.38***	.20***	.13***
	Negative Anticipated Outcomes				
BMI		Not Obese	Obese	Not Obese	Obese
	Friend Social Context ² →	.25***	.32***	.17*	.33***
	Anticipated Outcomes ² Friend Social Context ² →	.11**	.12**	NS	.16***
Education	Intention				
		No Four Year Degree	Four Year Degree	No Four Year Degree	Four Year Degree
	Home Social Context ¹ →	.20*	.35***	NS	.23**
	Self-efficacy Self-efficacy ¹ →	.46***	.58***	.37***	.60***
	Intention Teasing →	.57***	.29***	.41***	.39***
	Negative Anticipated Outcomes ²				

1. Finding was replicated on the validation sample.

2. Finding was not replicated on the validation sample.

3. All associations reported varied significantly between group through both single path and final model testing for moderation

* p < .05

** p < .01

***p < .001

To facilitate a post hoc analysis of the moderation results, the means and standard deviations for the computed variables associated with moderation by personal characteristics were computed. Few significant differences were found between group means. The calibration sample mean for teasing was greater for younger (5.5) than older respondents (4.01). The calibration sample mean for friend social context was greater for

non-obese (21.2) than for obese respondents (17.8). The mean for home social context was greater for those with a four year degree than for those without in both the calibration sample (26.5 vs. 23.1) and the validation sample (27.0 vs. 23.2). In the validation sample, the mean for negative anticipated outcomes was greater for those without a four year degree (47.9) than for those with a four year degree (43.9). The means and standard deviations for the variables associated with moderating effects of personal characteristics are presented in Table 5.4.

Table 5.4 Means and standard deviations of computed variables associated with moderation by personal characteristics.

Moderation by	Calibration Sample		Validation Sample	
	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)
Age	Young	Old	Young	Old
Self-efficacy ¹	33.0 (28.5)	32.3 (29.6)	31.7 (28.2)	30.4 (28.0)
Anticipated outcomes ¹	81.1 (35.5)	76.8 (37.0)	82.7 (34.4)	80.2 (36.6)
Teasing ²	5.5* (8.5)	4.1* (5.7)	4.9 (7.4)	4.3 (7.0)
Negative anticipated outcomes ¹	49.3 (25.2)	46.5 (21.9)	46.9 (24.3)	44.0 (23.0)
BMI	Not Obese	Obese	Not Obese	Obese
Anticipated outcomes ¹	82.0 (35.8)	76.0 (37.0)	82.3 (35.5)	82.5 (34.9)
Friend social context ²	21.2* (16.0)	17.8* (15.0)	21.3 (16.9)	20.7 (16.9)
Intention ²	61.6 (42.0)	57.2 (38.7)	60.1 (43.6)	57.6 (40.9)
Education	No four year degree	Four year degree	No four year degree	Four year degree
Home social context ²	23.1* (16.9)	26.5* (18.2)	23.2* (18.0)	27.0* (18.0)
Self-efficacy ¹	31.8 (28.4)	33.5 (29.5)	30.2 (26.0)	32.1 (30.1)
Intention ¹	57.6 (38.1)	60.8 (43.2)	58.6 (40.2)	58.7 (44.6)
Teasing ²	5.5 (8.4)	4.6 (6.8)	5.0 (8.1)	4.5 (6.3)
Negative Anticipated Outcomes ¹	47.6 (23.5)	48.9 (24.7)	47.9* (24.9)	43.9* (22.8)

1. Values range from 1-125 after transformation.

2. Values range from 1-64 after transformation

* Between group means differ ($p < .05$).

Discussion

Previous research assessed the impact of the behavior of friends and family on physical activity behavior. This study explored the interpersonal influence of workmates in addition to that of friends and family and found no unique association between their behavior and the intentions of subjects to participate in physical activity. This finding supports the tendency of researchers to ignore this potential source of influence on physical activity.

Other social contexts were found to be more strongly associated with intention, not a surprising result, as cohabitants and friends might well be expected to exercise more influence than co-workers who may or may not have multiplex relations with respondents. Accordingly, friend social context was positively associated with intention both independently, as well as indirectly through self-efficacy and positive anticipated outcomes, findings which were replicated on the validation sample.

While the association between friend social context and self-efficacy was stable across the personal characteristics tested for moderating effects in this study, the same is not true for the associations with anticipated outcomes and intention. While moderation testing on the calibration sample found no between group difference, the replication tests found that the association between friend social context and positive anticipated outcomes associated with physical activity was significantly stronger for obese than for non-obese respondents. Additionally, the relationship between friend social context and intention was significant for obese respondents and was not significant for non-obese respondents. While the absence of concurrence between the two samples precludes a

strong conclusion, it is suggestive of a partial explanation for the pattern of obesigenesis found among friends by the research of Christakis and Fowler.

It can be inferred from this result that obese individuals may be more sensitive to influences from the social environment than are their non-obese peers. This could be explained by a need for second hand information in the absence of firsthand experience – activity levels among obese individuals are lower than those of non-obese peers. Interestingly, there is no association between friend social context and negative anticipated outcomes for physical activity.

Following the logic underlying the previous two findings, it may well be that obese respondents had more direct experience with the *negative outcomes* associated with physical activity and are thus more independent of friends influence in this regard. Post hoc analysis revealed that the mean levels of negative anticipated outcomes are significantly higher for obese than for non-obese respondent. Perhaps, the impact of negative outcomes of physical such as discomfort and the time demands of regular activity are readily recognized with few attempts. The impact of positive experiences may be realized only with more bouts of physical activity which obese individuals are less likely to experience than are non-obese individuals.

For individuals who are already overweight and at risk for obesity, one pathway to obesity may lie in a friendship environment which is populated with obese friends who are unlikely to report positive outcomes to physical activity. For overweight individuals who have had a limited number of unpleasant experiences with physical activity, the absence of countervailing positive opinions may leave them disinclined to persist (or

even initiate) in the development of a physical activity routine. This line of analysis should be explored in more detail from a stages of change perspective which might shed light on the types of transformative experiences that could reverse these expectations.

Home social context was associated with self-efficacy, positive anticipated outcomes, and negative anticipated outcomes, consistent with research on the association of general measures of both social support¹³⁻¹⁵ and descriptive norm⁶ with self-efficacy. All of these findings were not consistent across all subsets of the study sample, however.

The positive relationship found between home social context and self-efficacy - replicated in validation sample analysis - was weaker (nonexistent in the validation sample) for those with less than a four year college degree than for those with a four year degree. For whatever reason, the observed variance in responses to self-efficacy items is less for those without a four year degree than for those with a four year degree. This difference may well account for the difference in the strength of association between the home social context and self-efficacy.

Home social context was also positively associated with anticipated outcomes for physical activity, a finding that was repeated consistently across both samples and in all tests of moderation. This result is at odds with studies which found no independent association between generalized measures of social support and anticipated outcomes^{6,9, 13-15} or between the descriptive norm and anticipated outcomes.⁶ It is possible that sample differences (this research did not focus on college students) account for this difference in results.

The association between the error terms for self-efficacy and anticipated outcomes was significant in all analyses. Interestingly, the association varied across two of the three moderators tested, age and body composition. One possible explanation of this relationship is that with successive attempts to participate in physical activity individuals produce an evaluation that may contain elements of both self-efficacy and anticipated outcomes for physical activity. Behaviors with a high starting value (positive anticipated outcome) are more likely to be performed frequently. Frequent behavioral attempts are likely to lead to successful performance of the behavior, which in turn will probably lead to increasing confidence in a person's ability to perform it. Thus a convergence between value and feasibility occurs. Conversely, people are more likely to attempt to perform a behavior at which they feel confident in performing. The more often a behavior is performed, the greater likelihood that the benefits associated with the behavior will be realized. Again, a convergence between value and feasibility occurs.

People who are older have had more opportunities to participate in physical activity than those who are younger. The association between anticipated outcomes and self-efficacy was stronger for older respondents than for younger ones in the calibration sample and this finding was replicated in analysis of the validation sample.

The association between anticipated outcomes and self-efficacy was stronger for non-obese than for obese individuals in the calibration sample only. Body composition is negatively associated with physical activity. Hence those who are not obese and are, therefore, likely to have experienced more regular physical activity will have had more opportunities to perform post-behavioral evaluations of self-efficacy and outcomes of

activity. The difference in these two moderational finding (one replicated and one not) is that opportunities for evaluation more consistently differentiates the old and young than it does the obese and non-obese, hence the moderating effect is more robust for age than for body composition.

The independent, positive associations found between self-efficacy and intention are consistent with considerable previous research.⁶⁻¹⁵ Interestingly, in this study, the association between self-efficacy and intention was stronger for those with a four year degree than for those without. The finding appears to be driven by a higher level of variability in responses to both self-efficacy and intention items for those with four year degrees. The between group difference in the standard deviations for these variables was consistent across both samples. It is worth noting further that while a difference did exist between groups, there was still a moderate association between self-efficacy and intention even when a between group difference existed. As one would suspect from the mass of previous research supporting the independent relationship between self-efficacy and intention, the relationship was robust, even if significantly different between groups.

Implication for theory

In contrast to the assertions of the Theory of Planned Behavior²⁶ and the Integrated Behavioral Model,² social context factors appear to be mediated by self-efficacy and anticipated outcomes rather than causally contemporaneous with them. This finding concurs with the predictions of Social Cognitive Theory and the work of a number of scholars who have found that self-efficacy or perceived behavioral control at least partially mediated the relationship between interpersonal influence and intention.^{6,13,}

^{15,27,28} It extends their findings in that the measures of interpersonal influence assessed in this study included items measuring the descriptive norm, something anticipated only by Okun and associates.⁶ In fact, of the four indicators assessing each of the social contexts, the companionship social support factor was the worst fitting in each case, leaving the bulk of the factors' covariances to be determined by reports of normative behavior and speech, as well as encouragement to participate in physical activity.

Implications for interventions

This study has tentative import for those seeking to impact the physical activity behavior of sub-populations associated with lower levels of activity than their peers. Those without a four year degree showed similar mean levels of self-efficacy but lower levels of variance in their responses than did their peers with four year college degrees. For those with lower levels of education, attributional retraining³⁰ may help them develop a more *differentiated* understanding of the impact of specific barriers to behavioral performance and lead to a greater sense of self-efficacy, overall. This in turn could lead to increases in intention and behavior.

A final summary of the results of mediation testing as they relate to intervention work follows:

1. Relationships within work contexts provide little opportunity for changing intention because of the absence of a pattern of independent association between this context and intention;
2. Relationships within home contexts provides an excellent opportunity for changing behavioral intention and should, therefore, be the target of interventions targeting self-efficacy and anticipated outcomes (pros and cons);

3. Relationships within the friend contexts provide another excellent opportunity for impacting behavioral intention and are, therefore worthy of interventions targeting self-efficacy and anticipated outcomes.

The unhappy irony of this situation is that work contexts that involve organizations (as opposed to self-employment) are an efficient way to target a large number of people with health promotion interventions, given the support of organizational leadership.

This study did not assess the degree to which *interventions* in different social contexts have different levels of influence. Rather, it explores the potential *flow on impact* that might be obtained through interpersonal influence. Accordingly, worksites may be the preferred location for intervention programming, especially if it encourages interactions related to physical activity with those in home and friend social contexts.

Limitations

Several limitations are worthy of mention in this study. Self-report, retrospective survey data are subject to distortions from social desirability, expedient rather than informative response patterns (marking all responses the same), and memory failure.³¹⁻³³ Accordingly, all results should be considered with these concerns in mind.

As is always the case with structural equation models, the existence of associational pathways does not constitute sufficient evidence of causation.²² Other considerations such as temporal sequence (not demonstrably supported in this cross-sectional data), reasonableness, and effective accounting for unobserved variance (not supported by invariance test results in this study (see Sobel, 1990) must be satisfied.³⁴

The lack of sufficient sample variety to test for moderation by gender and by race/ethnicity is regrettable. Given the association between these factors and activity levels,²⁹ it is reasonable to expect that more nuanced results would have been produced if these analyses were possible. The same concern applies to a stages of change analysis.³⁵ Moderation testing by stages of change could have produced results with greater theoretical specificity, as well as more clear application to intervention activities.

Finally, a Social Context Model of Interpersonal Influence on intention to participate in physical activity can, in conjunction with moderation testing, provide information about the sources of interpersonal influence most likely to impact targeted sub-populations. It is less useful for providing information about the *types of influence* that are most critical for changing behavioral intention. To gather both of these types of information, latent factor analysis must be supplemented by other analytical approaches such as multiple regression that allow for the assessment of association between specific aspects of interpersonal influence and intention to participate in physical activity.

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CHAPTER 6

INTERPERSONAL INFLUENCE ON ADULT LEISURE TIME PHYSICAL ACTIVITY: ASSESSING A MEDIATIONAL MODEL

Introduction

Christakis and Fowler¹ found that the friends of individuals who became obese were more likely to become obese themselves at a future time than were friends of non-obese individuals. This finding suggests that researchers in obesity would be well served to understand the interpersonal influences on primary determinants of obesity – physical activity and dietary behaviors. This paper explores the patterns of association between interpersonal influence and physical activity behavior, its mediation by self-efficacy, anticipated outcomes, and intention as well as its moderation by age, education, and body composition.

Fishbein² described the theoretical synthesis produced by a number of prominent health behavior theorists as part of a conference sponsored by the National Institutes of Mental Health. They found that behavior was predicted by three proximal determinants - behavioral intention, the skills required to perform the behavior, and the absence of environmental constraints that precluded behavioral performance. They also found that attitudes, norms, self-standards, emotional reactions, and self-efficacy were distal determinants of behavior. Montano and Kasprzyk have used this work to develop an Integrated Behavioral Model (2008) which also draws heavily on the Theory of Planned Behavior. Figure 6.1 provides a graphic summary of their findings, referred to hereafter as the NIMH model.

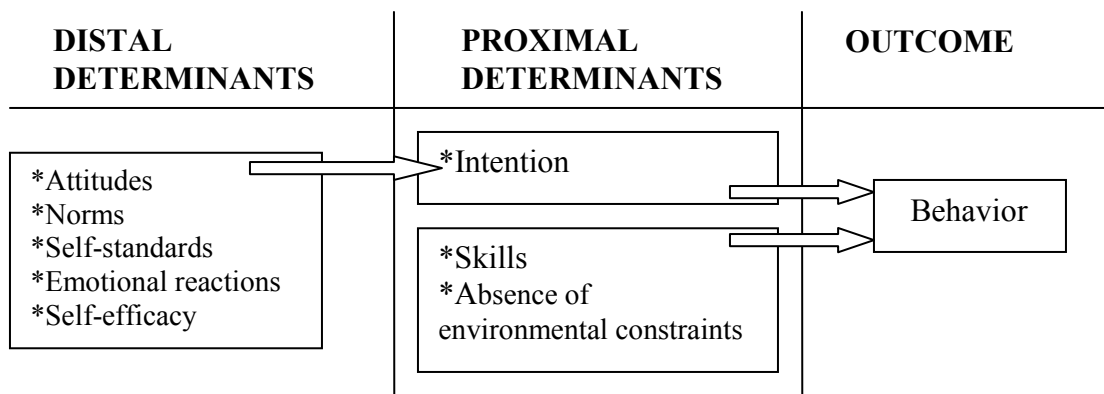


Figure 6.1. The “NIMH” model (based on Fishbein, 1995)

Four problems with this approach are addressed in this paper. First, Fishbein does not include social support in the discussion. There is considerable evidence (to be discussed below) that points to social support as a significant source of interpersonal influence. Next, no attempt was made to differentiate the causal sequence relating social norms, on one hand, and self-efficacy and anticipated outcomes, on the other. Thirdly, social norms are assessed as injunctive norms which are based on a person’s perception of what his significant others think he should do. The injunctive norm has been found to be inconsistently associated with physical activity, at best.³⁻⁵ More recent research has employed the descriptive norm (a person’s observations of common behavior) with more success.⁶⁻⁸ A fourth feature of the approach employed in this study relates to the general approach to assessing interpersonal influence. It is typically assessed with regard to family and friends, but less closely affiliated work associates are ignored. This study accounts for these concerns and assesses the mediation and moderation of the relationship between interpersonal influence and physical activity.

Review of Literature

Drawing on the model of Fishbein in Figure 1, three psychological mediators are considered for their putative association with physical activity. Behavioral intention has generally been found to be independently and positive associated with subsequent physical activity^{3, 4, 9-15} except when prior physical activity was included in a regression model.¹⁵⁻¹⁷ Self-efficacy and its Theory of Planned Behavior analogue, perceived behavioral control, have been found to be positively and independently associated with physical activity.^{3,4,9,11,12,15, 18-20} Thirteen studies reporting on the self-efficacy – behavioral intention relationship since 2000 found an independent association between these factors.^{5,6,9, 10,14,15-17,21-25} There is also ample and nearly unanimous evidence that an independent association also exists between anticipated outcomes and intention to participate in physical activity.^{5,6,9,10,12,14-17, 22-24}

Interpersonal influence

The constructs comprising interpersonal influence in this study are social support and the descriptive norm. Nine papers published since 2000 were found that presented results regarding tests of association between social support and physical activity behavior. The findings of these papers are strongly suggestive, but not conclusive with four finding independent associations;²⁶⁻²⁸ four finding bivariate associations and not explicit testing reported for independence;^{9,18,30,31} and one finding no bivariate association.³²

Little research has accumulated regarding the relationship between the descriptive norm and physical activity. Two reviews reported mixed results regarding the

association between observing the physical activity behavior of others and one's own physical activity behavior.^{3,33} Two studies reported results on the association between the behavior of others (not significant to the respondent) and physical activity behavior.^{34,35} One found an independent association.³⁴ Four studies reported on the possible association between the physical activity behavior of significant others and the respondents physical activity behavior. Two found a bivariate association,^{17,34} one tested the association for independence and found no association.¹⁷ Two other studies found independent associations between the behavior of friends and leisure time exercise²⁵ and vigorous leisure time exercise (but not total leisure time exercise)²⁴ when using regression models that included perceived behavioral control, attitudes, and intention. Taken as a whole, the evidence is not conclusive.

Study Aims

The theoretical aim of this study is to determine if a measure of interpersonal influence comprised of social support and descriptive norm assessed across three social contexts (work, home and friendship), and modeled as causally prior to self-efficacy and anticipated outcomes can be used to predict physical activity behavior. The first applied aim of this study is to identify psychological factors that mediate the associations between interpersonal influence and physical activity. The second applied aim is to identify personal factors that moderate those psychologically mediated pathways.

Methods

Sample

Data come from an employee wellness program evaluation performed at a major healthcare provider in the southwest prior to a worksite health promotion initiative. Subjects were recruited through intranet emails and were promised a chance to win an iPod if they completed both pre and post program surveys. Respondents accessed the online survey by following a link embedded in the email. Over 1,240 responses were received, with 1,224 providing usable data at time 1. This sample did not differ from the worksite population in terms of gender, race/ethnicity, or age. Neither body composition nor educational attainment data were available on the population. From the original sample, 393 of these provided usable physical activity at both time one and time two and were selected for the studies reported here. This subset did not differ from the total sample in terms of any of the personal characteristics assessed. Respondents were predominantly female (83.7) and white (82.4%), A majority were younger than 45 years of age (64.9%), had at least a four year college degree (54.9%), and were not obese (62.8%).

Measures

Social support and descriptive norm were assessed across three social contexts – occupational, home, and friend. For each of these contexts, respondents were presented with a series of forced choice Likert type questions, each with four response levels and anchored by Strongly Disagree (=1) and Strongly Agree (=4). Social support items employed in these data addressed encouragement to be physically active and

companionship for physical activity, but did not address appraisal or informational support. The descriptive norm items assessed the respondents' perceptions of others' discussion of and participation in regular physical activity. A question assessing negative interpersonal influence (teasing about one's athletic ability) in each social context was also included.

The survey included three items assessing behavioral intention, two expressed positively and one negatively. The two positive items were expressed as intention, whereas the negative item was expressed as an expectation.¹³ The questions were prompted with the heading "Your plans for Spring" and were anchored by the evaluations "Strongly Disagree" (1) and "Strongly Agree" (5). In order to achieve a high level of concordance with the primary dependent measure, meeting physical activity guidelines during the spring of 2008, the items specified both the time period and the frequency and duration of physical activity required.

Self-efficacy was assessed using four items that specified common barriers to physical activity. Two items were taken from Marcus and associates³⁶ and a third had been included in worksite wellness programming assessments over a four year period. The final item was adapted to local conditions from one used by Marcus and associates³⁶ to assess the influence of weather on self-efficacy. The items were prompted with the statement "Circle a number to indicate how confident you are that you could be physically active and/or exercise in each of the following situations." Response options varied from 1-5 and were anchored by the expressions "Not at all Confident" and "Extremely Confident." A stem was provided "How confident are you that you could be

physically active or exercise when...” and was followed by four items that addressed rain or excessive heat, tiredness, “not much time”, and a “tight schedule.”

Anticipated outcomes for physical activity were assessed with six items that consisted of both outcome expectations and outcome expectancy components. Outcome expectancy³⁷ refers to the value placed on an outcome, whereas the concept outcome expectations refers to the anticipated consequence(s) of behavior. In these questions, the expectancy component is expressed in the stem that precedes the question block: “Please rate how important each of these statements is in your decision of whether to be physically active. In each case, think about how you feel right now, *not how you have felt in the past or would like to feel.*” This prompt is followed by a set of four items expressing positive outcomes and two expressing negative outcomes. Three of the positive items expressed psychological benefits and one expressed a physical benefit, all of which were instrumental in nature because of the delayed aspect of their realization. The values represent the importance of the outcomes described in each statement with anchors of “Not At All Important” (1) and “Extremely Important” (5).

Physical activity is measured using the Global Physical Activity Questionnaire. The GPAQ³⁸ (version 2) was employed here as a measure of physical activity. The psychometric qualities of the GPAQ compare favorably to the International Physical Activity Questionnaire – long form³⁹ with which the concurrent validity of GPAQ (version 1) was assessed. Items used in this study assessed the number of days/week, hours/day, and minutes/day of both moderate and vigorous leisure time physical activity.

In this study, measures of total leisure time activity at time one (TLTA1) and time two ((TLTA2) were computed in terms of MET units from GPAQ data.

The following equations were used to compute these measures:

Moderate leisure time activity = (days/wk x minutes/day moderate activity) x 4 MET units

Vigorous leisure time activity = (days/wk x minutes/day vigorous activity) x 8 MET units

TLTA = Moderate leisure time activity + Vigorous leisure time activity

The amount of missing data and number of outliers in the sample were negligible. Many of the study variables were non-normally distributed. Social context and psychological mediator variables were transformed and regular maximum likelihood estimates were generated.

Model Development

The approach used in this study begins with a Social Context Model of intention to participate in physical activity that was developed in a previous study. In the first study reported here, the model is used to predict subsequent physical activity reported for the months of February through May of 2008. In the second study, total leisure time physical activity reported in February is added to assess the extent to which the model adds predictive information above that gained from prior behavior. These models are presented in Figure 6.2.

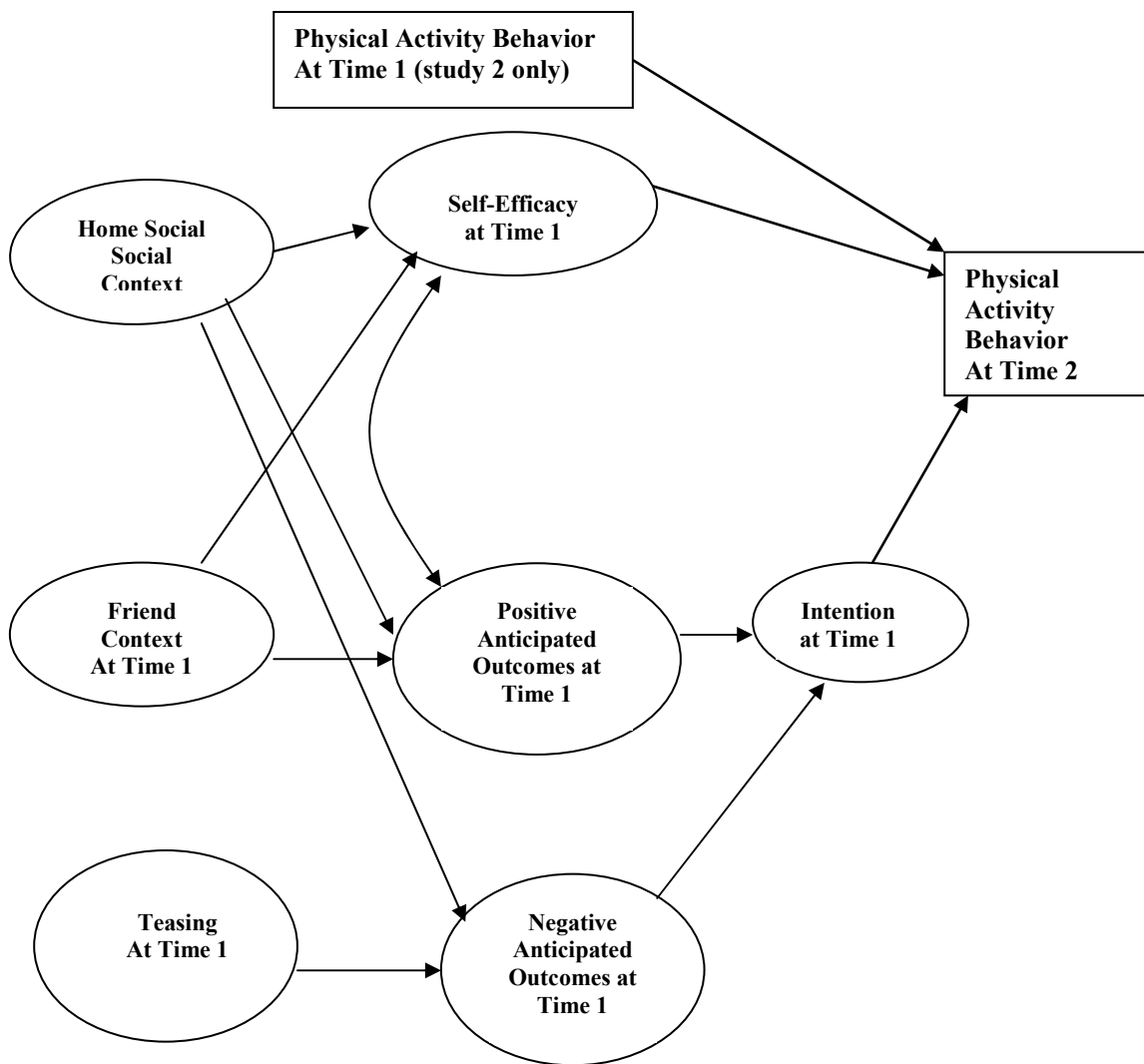


Figure 6.2. The Social Context Model of Interpersonal Influence on Physical Activity.

Model Fit

A baseline structural equation model was fitted to the validation data set using Mplus 5.1⁴⁰ for analysis. Kline⁴¹ recommends evaluating model fit in terms of four factors – model $\chi^2/\text{d.f.}$; C Fit Index (CFI); Root Mean Square Error of Approximation (RMSEA); and Standardized Root Mean Square Residual. For large samples, the model $\chi^2/\text{degrees of freedom}$ ratio is used as an indicator of model fit and values of 3.0 or less

are acceptable. The Comparative Fit Index (CFI) provides an incremental measure of model fit, and values of .90 and above are considered acceptable. The Root Mean Square Error of Approximation (RMSEA) provides for estimates of good model fit and is more appropriate to over-identified models than procedures comparing models to a standard of perfect fit. Point estimates, 90% confidence intervals, and a probability of good model fit are used to determine hypothesis evaluation. Values of .05 and below are indicative of good model fit, between .05 and .08 indicate acceptable fit, and those equal to or greater than .10 are considered indicative of poor fit.⁴¹ The Standardized Root Mean Square Residual provides an estimate of the mean correlation residual; values of less than .10 are considered indicative of good fit.

Moderation Testing

Multi-group models were used to assess moderation by age, educational attainment and body composition. A baseline model was allowed to vary freely across paths to calibration sample data. Age was assessed by comparing those younger than 45 years of age with those 45 years of age and older. Educational attainment was assessed for a moderating association by comparing those with at least a four year college degree with those who did not obtain a four year postsecondary degree. Body composition was assessed for moderating association by comparing obese (BMI greater than or equal to 30) and non-obese individuals.

Once baseline model values were established, each path in the structural model was constrained to be equal across groups, one path at a time. The decrement in model fit was assessed by χ^2 difference testing.⁴¹ Path constraints associated with a minimum

threshold value of 3.84 were considered to significantly decrease model quality and were rejected.

A final test of difference between groups involved the fitting of a model with an equality constraint placed on all paths not found to be different through the single path constraint method used in the previous step. This “final” model was compared to the original model with no paths constrained. A model that did not represent a significant decrement in model fit based on the χ^2 difference test employed in step 2, was accepted as a parsimonious model of the data. Paths that were still observed to vary across groups in this model were considered to represent best estimates of between group differences in associations between factors.

Results

When interpersonal and psychological factors were computed *as means of their indicators*, study variables were generally correlated. There was no association between teasing and three variables – total leisure time activity at time one, total leisure time activity at time two, and intention. The friend social context was not associated with leisure time activity at time two (although it was associated with activity at time one). Table 6.1 presents the means, standard deviations for measured (computed) forms of all study variables.

Table 6.1. Bivariate correlations, means, and standard deviations of study variables.¹

Variable	1	2	3	4	5	6	7	8	9
1. TLTA2	—								
2. TLTA1	.29**	—							
3. Intention	.23**	.41**	—						
4. Self-efficacy	.26**	.38**	.62**	—					
5. Positive Anticipated Outcomes	.10**	.19**	.42**	.37**	—				
6. Negative Anticipated Outcomes	-.15**	-.29**	-.43**	-.38**	-.23**	—			
7. Home Social Context	.17**	.15**	.28**	.33**	.27**	-.16**	—		
8. Friend Social context	.13	.18**	.41**	.38**	.31**	-.27**	.31**	—	
9. Tease	.07	-.12	.09	-.12**	-.16**	.12**	.00	.12*	—
Mean	1296	430	3.50	2.73	4.11	2.06	2.57	2.38	1.32
Standard Deviation	2371	989	1.01	1.01	.84	.82	.83	.78	.47

1. Correlations, means, and standard deviations computed on the reduced data set.

* Correlation is significant at the .05 level.

** Correlation is significant at the .01 level.

The initial model fit the data well, but only self-efficacy was independently associated with VLTA2. Paths representing all other associations with physical activity were dropped one at a time with the order based on the descending magnitude of their non-significant p-values. This “trimming” of paths was not associated with a decrement in model fit, as judged by χ^2 difference testing. The resulting model was the most parsimonious option available. It fit the data well with model χ^2 /degrees of freedom ratio of 1.70; a CFI value of .95; RMSEA values of .042 (c.i. = .036-.048), and an SRMR value of .07. The model explained 9.2% of the variance of VLTA2, 53% of the variance of intention, and 17% of the variance of both self-efficacy, 24% of the variance of positive anticipated outcomes, and 15% and negative anticipated outcomes. Figure 6.3 provides a graphic depiction of the regression results of the model predicting total leisure time energy expenditure at time two.

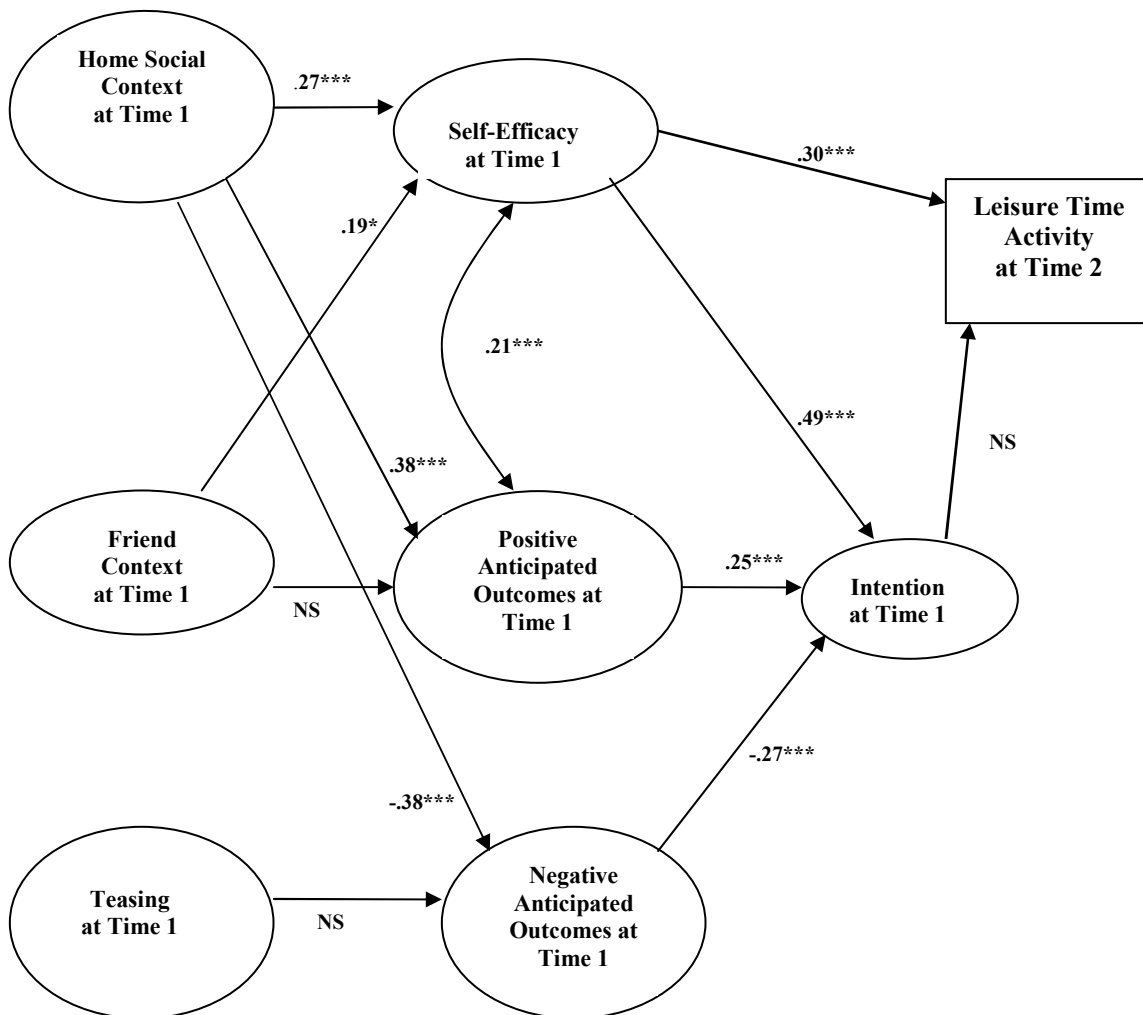


Figure 6.3. The prediction of time two total leisure time physical activity (TLTA2) by the Social Context Model of Interpersonal Influence on Physical Activity

Mediation of Interpersonal Influence by Psychological Factors

The TLTA2 model of physical activity was evaluated for mediation of interpersonal influence by psychological factors. Home social context was associated with total leisure time energy expenditure through self-efficacy. This suggests that home contexts that reflect greater evidence of and support for physical activity are associated

with higher levels of self efficacy which are, in turn, associated with higher levels of total leisure time energy expenditure. The standardized, indirect association between the home social context and TLTA2 was .08 ($p < .01$).

Friend social context was associated with vigorous leisure time energy expenditure through self-efficacy. This suggests that friend contexts that reflect greater evidence of and support for physical activity are associated with higher levels of self efficacy which are, in turn, associated with higher levels of total leisure time energy expenditure. The standardized, indirect association between the friend social context and TLTA2 was .06 ($p < .05$).

Moderation of the Model Predicting Total Leisure Time Physical Activity

The TLTA2 model was used for moderation testing. Multigroup models for age, body composition, and education were estimated, first with all paths allowed to vary freely to establish a baseline model fit. The models for age and education converged, facilitating further analysis. The model for moderation by body composition did not, making further analysis impossible.

The single path equivalence tests found only the relationship between self-efficacy and total leisure time activity to vary significantly across age groups. This finding was supported in the final model which constrained all other paths to be equal across groups. In the final model, the association between self-efficacy and total leisure time activity was stronger for older ($b=.40$, $p < .001$) than for younger respondents ($b=.16$, $p < .05$).

Testing for moderation by educational level identified one path that varied between those respondents with a four year college degree and those without. The association between self-efficacy and total leisure time activity was larger in magnitude for those with a four year degree ($b=.39$, $p < .001$) than for those without a four year degree ($b=.23$, $p < .01$). Table 6.2 lists the means and standard deviations for both self-efficacy and total leisure time activity by age and education level.

Table 6.2. Means and standard deviations for variables involved in moderation testing.¹

Variable	Age		Education	
	Young Mean (s.d.)	Old Mean (s.d.)	No 4 Year Degree Mean (s.d.)	4 Year Degree Mean (s.d.)
Self- efficacy	2.73 (.98)	2.73 (1.07)	2.69 (1.02)	2.76 (1.01)
Total Leisure Time Activity	1326 (1998)	1241 (2945)	1202 (2258)	1378 (2464)

1. No significant difference exist between means.

The Prediction of TLTA2 with TLTA1

The second analysis reported involves a reduced set of respondents ($n=393$) who provided valid leisure time physical activity responses at both time 1 and time 2. These data were analyzed with a model that included time one interpersonal, psychological and total leisure time energy expenditure data as predictors of time two total leisure time

energy expenditure. The model fit the data well [$\chi^2/\text{d.f.} = 1.69$; CFI = .96; RMSEA = .042 (.036-.048)]. Total leisure time energy expenditure at time two was predicted by total leisure time energy expenditure at time one ($b=.12$, $p < .05$) and self-efficacy ($b=.28$, $p > .001$). The model explains over 9.3% of the variance in time two physical activity with previous physical activity and 9.2% of the variance without it. Moderation testing could not be performed because the models failed to converge. Figure 6.4 presents the regression results from this analysis.

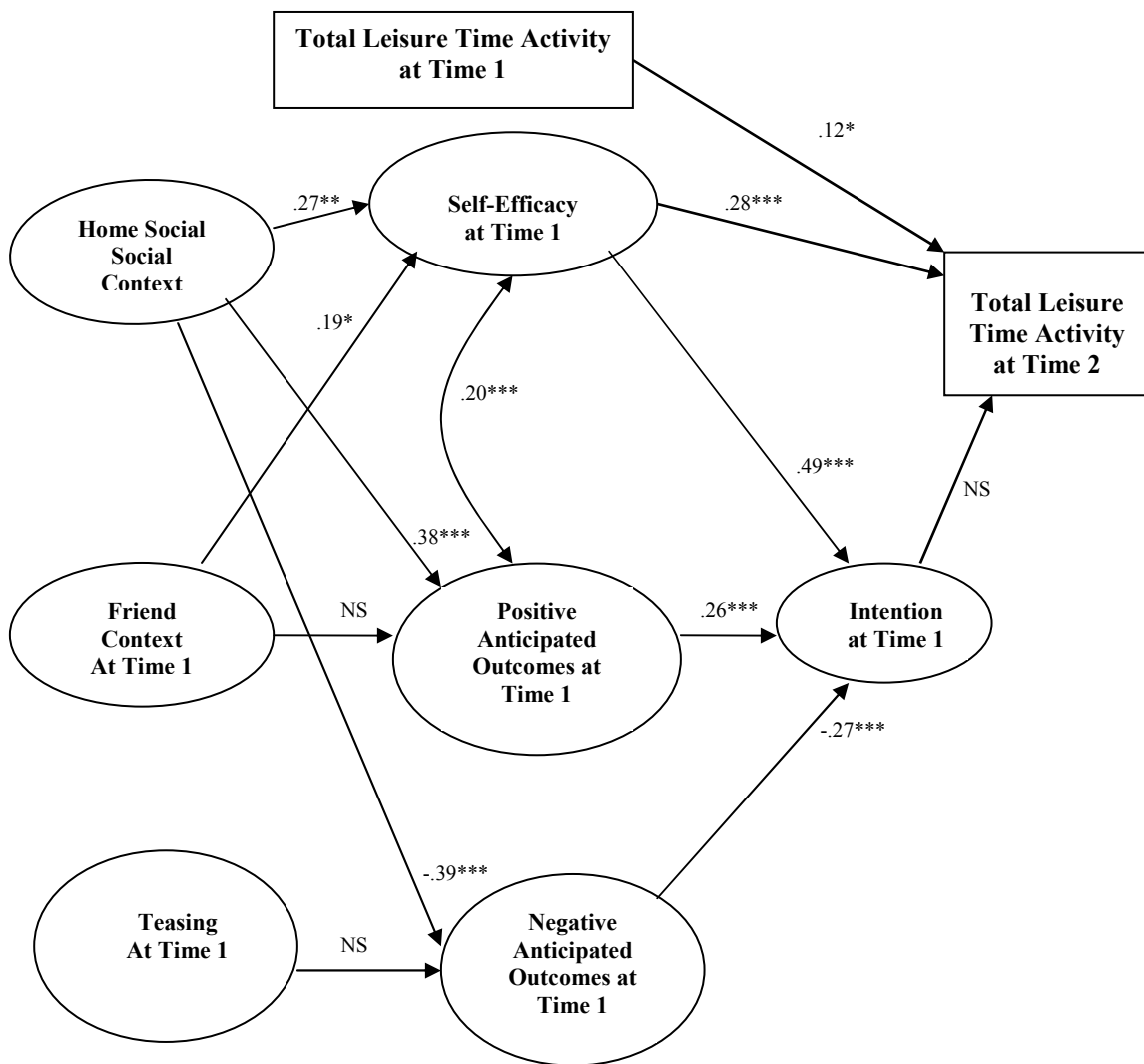


Figure 6.4. The prediction of time two total leisure time physical activity (TLTA2) by the Social Context Model of Interpersonal Influence on Physical Activity and time one total leisure time physical activity (TLTA1)

Discussion

The Social Context Model of physical activity predicted approximately 9% of the variance in total leisure time activity. This is a relatively small amount of explained variance, considering the factors involved. One explanation may offer some insight into this finding. Weakness in the predictive model may stem at least partially from response

shift. Response shift⁴² refers to a change in the survey respondents' frame of reference following exposure to experience or training. It is possible that respondents encountered different realities than were conjured up by intention items. If so, even response items tailored to elicit intentions that would reflect a high level of concordance with behavioral reports failed to connect with future realities. This notion is supported by the stronger association between self-efficacy measures and intention, perhaps arising out of the contingencies referenced by the self-efficacy items and lacking in intention items. These contingencies may well have resulted in more elaborate reflections on the part of respondents, especially those who are older and who have more education, as suggested by stronger associations between self-efficacy and behavior for these respondents.

In terms of interpersonal influence on physical activity, both the home and friend social contexts were associated with physical activity. This finding is consistent with previous research, although it extends the finding in that these measures of interpersonal influence include items assessing the descriptive norm and social support for physical activity. Also consistent with expectations, interpersonal influence is completely mediated by psychological factors, although the absence of independent association between intention and physical activity restricts mediating effects to those involving self-efficacy. In short, home and friend social contexts that are characterized by pro activity norms and social support are associated with higher levels of self-efficacy for physical activity and, subsequently, with physical activity itself. While their indirect associations with self-efficacy are consistent across age and education levels, their indirect association with activity varies because of the associations between the self-efficacy – physical

activity relationship and both age and education. Consequently, interpersonal influence as assessed in this study is stronger for older and for more educated respondents.

Balanced against this finding of differential impact is the fact that the indirect associations with physical activity are small in magnitude for both home ($b = .08$, $p < .01$) and friend relationships ($b = .06$, $p < .05$). It follows that the bulk of predictive information lies elsewhere and that between group differences are of minimal importance.

In the second study, the Social Context Model predicted time two total leisure time physical activity above and beyond that predicted by time one total leisure time physical activity. This surprising finding probably reflects several factors. As discussed above, response shift may account for the weak prediction of time two behavior by time one behavior. Employees who were inactive prior to the worksite wellness intervention and increased their activity levels in response to the intervention could contribute significantly to such an effect.

This research does not offer support for the work of Christakis and Fowler (2007) who found obesigenesis to be associated with friends and friends of friends, but not with family members. In this study, physical activity levels that are associated with obesity show slightly more influence by family members than by friends, although the differences are not large. The difference lies in the association between the social context and self-efficacy, with the association being much stronger between self-efficacy and the home context than it is between self-efficacy and the friend context. Full explanation of Christakis and Fowler's intriguing results requires more research to parse out more

carefully the relative merits of dietary habits and physical activity on obesigenesis and the mechanisms by which these factors impact the development of obesity.

Secondly, seasonal variation in physical activity may account for a significant lack of correspondence between the activity levels at time one and time two. Time one measurements were taken in February and asked respondents to describe their general physical activity behavior patterns. Time two measurements were taken in June and assessed specifically physical activity behavior from the time period between the two surveys. The earlier assessment may well have reflected reduced levels of activity often found during the winter season.⁴³

Limitations

The findings in this study apply to the adult worksite population from which the sample was drawn, assuming that no significant differences between the samples drawn and the population exist with regard to educational attainment and body composition, two factors for which population level data were not available. The results may not be consistent with research performed on college students on whom much prior research has been done. The possibility of seasonal variation mentioned above suggests another boundary condition that could serve to differentiate results from various geographic locales.

The most fundamental constraint on data interpretation is its self-report nature. As such it is subject to distortions from response sets such as social desirability⁴⁴ and patterned responses to similar question formats.^{45,46} Furthermore, these data were collected at the worksite, a consideration that raises the issue of enhanced response

desirability, although guaranteed anonymity may have helped to overcome this to some extent. It is also worth noting that, while anticipated outcomes items in this data set show little variability due to a ceiling effect with desirable attitudes about physical activity, other items assessing worksite climate and supervisor behavior (not presented here) reflect considerable variation. The observed variability in these sensitive items argues for less of a desirability impact on responses.

As is always the case with structural equation models, the existence of associational pathways does not constitute evidence of causation. Other considerations such as temporal sequence (not clear for associations between interpersonal and psychological factors), reasonableness, and effective accounting for unobserved variance (not completely supported by invariance test results in this study)⁴⁷ must be satisfied.

While this study attempts to assess interpersonal influence, there are a number of improvements that could be made in that regard. Social support is understood to arise from relationships involving resource exchange.^{48,49} More standard sociometric treatments (such as network analysis)⁵⁰ might well yield different results. The assessment of appraisal and informational self-support might make for a richer analysis of interpersonal influence, as well. Finally, the moderating effects of stage of change⁵¹ could certainly tell a more complex story that could be more informative for interventionists.

On a different note, the Social Context Model of interpersonal influence on physical activity is not useful for providing information about the *types of influence* that are most critical for changing behavioral intention. To execute this analysis, the latent

factor analysis conducted that led to the combination of social support and descriptive norm items must be supplemented by other analytical approaches such as multiple regression that allow for the assessment of association between specific aspects of interpersonal influence (such as companionship for exercise) and physical activity. Alternatively, a more complex model could be developed that provides for latent factor analysis of the specific aspects of interpersonal influence (again, companionship for exercise serves as an example) which are modeled only with single indicators here.

Summary

This test of the Social Context Model of interpersonal influence on physical activity validates the differentiation in temporal sequence between sources of interpersonal influence and psychological mediators such as self-efficacy and anticipated outcomes. It also supports the use of both social support and the descriptive norm as constructs appropriate for assessing interpersonal influence. Finally, it supports the approaches and findings of existing practices that assess influence through friendship and family channels, but ignore interpersonal influence through work associations.

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CHAPTER 7

DISCUSSION

Introduction

This study of a Social Context Model of Interpersonal Influence on physical activity generated several points of discussion – specific findings from scale development and the testing of mediational and moderating models; applications to physical activity interventions; and applications to behavioral theory. These are addressed in turn, beginning with scale development.

Scale Development

The Social Context Scale of Interpersonal Influence on physical activity differs from previous measurement approaches in a number of ways. It includes measures of descriptive norm, something only recently employed in a systematic way, although the impact of observing the physical activity of others has been a longstanding piece of population based studies (Gottlieb & Baker, 1986; King et al., 2000; Booth et al., 2000). This approach varies from previous work because it assesses both the awareness of others being active, as well as awareness of discussions of the topic of physical activity. It also differs from past approaches because it assesses not only those people from home and friendship relations (Booth et al., 2000; Jackson, Smith, & Conner, 2003; Ravis & Sheeran, 2003a), but also those who share the respondent's occupational environment. In this way, it represents a more comprehensive evaluation of a person's descriptive, normative influences than are typically employed.

Another facet of the measurement approach developed in this study is the inclusion of Social Support in the measurement of interpersonal influence. Social Support has long been a staple of physical activity research. Like the descriptive norm, it has seldom, if ever been assessed across home, friendship, and work contexts (Troost et al., 2002). Finally, the combination of the descriptive norm into a single factor representing interpersonal influence in a specific social context is different from previous measurement approaches.

This measurement approach appears to have yielded mixed outcomes. As a measurement model, the Social Context Model was a better fit to data, had superior convergent validity, and superior discriminant validity than did a model based on social support and the descriptive norm. It was also better than a one factor model that included all indicators. The internal consistency of the social context factors was excellent with alpha values .82-.85 (DeVellis, 2003). On the negative side, the fit of the baseline model with no indicators cross loaded and no indicator errors correlated was poor. Only the Standardized Root Mean Square Residual (SRMR) value was within acceptable limits. While the Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and model χ^2 /degrees of freedom indicated poor fit (Kline, 2005).

While the apriori specified error correlations resulted in an excellent fit to data, the initial poor fit is of concern. On one hand, simple structure does not exist as the scale is currently constructed, as evidenced by the cross loaded factor. Furthermore, error correlations imply the existence of other variables impacting indicator values (Kline, 2005).

While one can interpret the successful use of apriori error correlations as a sign that response set impacted responses; that may be a generous interpretation. In fact, less than 50% of the variance was explained in each of the companionship indicators. Beyond that, a post hoc evaluation of a three indicator model of social context (no companionship indicators) resulted in improvement in the SRMR and CFI values, but not RMSEA or χ^2 /degrees of freedom. It follows that while this model was superior to the alternatives tested, it leaves something to be desired.

The notion of assessing interpersonal influence in terms of social context factors is intuitively appealing. Given a social context in which many people are active and discuss their activity, it is reasonable to expect that individuals will be likely to be given encouragement to participate in physical activity and to find one or more companions from that setting with whom they can exercise. While the logic appears to hold true at some level, more work needs to be done to develop an instrument that presents less of an error term. Given the initial fit statistics and magnitude of the indicator residuals, the results of this study should be viewed with some caution (Kline, 2005).

Behavioral Intention

The study of interpersonal influence on behavioral intention yielded several key findings. These include the validity of the Social Context Scale, the causal order implied by the structure of the Social Context Model of intention to participate in physical Activity, the mediation of the interpersonal influence – intention relationship, and the moderation of those patterns by age, educational attainment, and body composition.

Construct Validity

The factors that comprised the Social Context Scale were correlated with each of self-efficacy, anticipated outcomes, and intention. These results suggest that the scale possesses construct validity (DeVellis, 2003). Magnitudes of correlations in the calibration sample vary from the correlation between the work context and anticipated outcomes ($r=.20$, $p < .01$) to the correlation between the friend social context and intention ($r=.35$, $p < .01$). This compares favorably with reports from studies beginning in 2000 of nine Pearson correlations between social support and intention that varied between .18 and .33 with a median of .23 (Okun et al., 2003; Plotnikoff et al., 2008; Rovniak et al., 2002; Courneya et al., 2000).

Mediation

The Social Context Model of Interpersonal Influence (SCMII) places social factors causally prior to self-efficacy and anticipated outcomes. This is at odds with both the results of the NIMH conference on health behavior synthesis (Fishbein, 1995) and the Integrated Behavioral Model that is derived from it (Montano & Kasprzyk, 2008), but consistent with the predictions of Social Cognitive Theory (Bandura, 1986). The complete mediation of the associations between home and friend social contexts and intention suggests that perhaps the SCMII offers a more accurate representation of the relationship between interpersonal influence and intention than these other models. The absence of an independent association between work social context and psychological mediators may point to the overlap between friend and work social contexts to the extent that co-workers influence each others orientation toward physical activity. This finding

also supports existing approaches that do not typically assess worksite influences separately from friend and/or family influences.

Moderation

Moderation effects signal boundary conditions that carry at least one theoretical implication, limits to causal inference (Sobel, 1990), and one relevant to intervention work - a more precise definition of a target population reflected in the categories of the moderator defined subgroups. In this study, age, educational attainment, and body composition were all associated with moderating effects on at least two pattern of association, with a total of seven in all. Three of these were replicated on the validation data set.

Older age was associated with a stronger association between the disturbance terms for self-efficacy and anticipated outcomes, a finding that was replicated on the validation data set. This finding suggests a feedback loop between behavioral evaluation and subsequent evaluations of self-efficacy and anticipated outcomes – a finding that is consistent with perception control understandings (Montano & Kasprzyk, 2008). A similar finding was made in the validation sample analysis with regard to body composition and the self-efficacy – anticipated outcomes disturbance terms. The association between these error terms was found for those who are not obese but not for obese respondents. This finding suggests that non-obese respondents were more strongly influenced by post activity evaluations than were obese respondents. This result is sensible given that non-obese respondents are likely to be physically active and, therefore, likely to have more opportunities to reflect on post activity evaluations. The

significance of the association between the disturbance terms for self-efficacy and anticipated outcomes will be addressed in more detail in the theoretical application section.

The key finding in this study suggests a partial explanation of the results of Christakis and Fowler (2007) and rests on a mixed result. The association between body composition and the relationship between the friend social context and anticipated outcomes was not found in the analysis of the calibration sample, but was identified in the analysis of the validation sample. Analysis of the latter sample found that the relationship between the friend social context and anticipated outcomes is stronger for obese respondents than for non-obese respondents. This may represent a partial explanation for increased levels of obesigenesis among the associates of obese individuals. As a group, obese individuals participate less in physical activity (Centers for Disease Control and Prevention, 2007). This lack of experience may render them more sensitive to the influence of their friends than are individuals who participate in physical activity more frequently and consequently have more opportunities to evaluate its potential benefits. Further research is required to determine the robustness of this finding, as well as the patterns of communication through which this influence passes. Only then can thoughtfully targeted and constructed messages be developed for physical activity promotion interventions.

The balance between first and second hand experience may be greater with regard to the negative outcomes associated with physical activity. In terms of the measures used in this study, the difficulties of scheduling physical activity are readily recognized, as is

the discomfort involved in activity. It is perhaps worth noting that no between group differences were found in the association between home social context and negative anticipated outcomes. Together these findings are consistent with a generally recognized problem facing those who promote physical activity – it is easy enough to recognize the hardships, but seeing the benefits takes a bit more time.

Educational attainment was associated with three different patterns of moderation, one of which was replicated across the data sets and a second that received a weak indication of replication with a marginal finding on the validation data set.

Two of these findings collectively hold import for those seeking to impact adults with less educational attainment. Analysis of the calibration data set found that home social context was associated with self-efficacy for those with a four year college degree and not for those without in the calibration sample, but not in the validation sample. If those with four year degrees are more inclined to make specific attributions about their efficacy for exercise, there would likely be more variability that could be associated with differences in home social context for physical activity; hence a stronger pattern of association would emerge. The variance in self-efficacy responses was greater for respondents with a four year degree than for those without. The difference in variance between the groups was greater in the calibration sample. This offers some support for the explanation at hand.

The positive association between self-efficacy and intention was greater in magnitude for those with a four year college degree than for those without. This finding was replicated on the validation sample. In this case, there is clearly more variance in the

intention responses of those with four year degrees than in respondents without a college degree and the difference is consistent across both samples.

A finding on the calibration sample that was not replicated was that the association between teasing and negative anticipated outcomes was larger in magnitude for those without a four year degree than for those with. Following the logic employed earlier, if negative anticipated outcomes are arrived at with less experience than positive ones, an alternative explanation for frequency of participation in physical activity must be applied to this finding. One possible explanation is that those with four year degrees have, on average, a clearer understanding of the physical demands of exercise as well as more adeptness at resolving scheduling difficulties entailed by the time demands associated with regular exercise. Accordingly, they may be influenced by second hand information about physical activity and more dependent on other sources of information which influence their assessment of barriers to exercise.

Physical Activity Behavior

Total leisure time activity (TLTA2) was predicted by home and friend social contexts through self-efficacy. This finding was consistent across models that did and did not include total leisure time activity at an earlier time. The indirect association of these factors with total leisure time activity was small in magnitude. Based on these results, the social context cannot be viewed as a major factor in shaping physical activity behavior. Other approaches to assessing this relationship might yield different results and will be discussed later.

The null finding regarding the association between intention and TLTA2 is consistent with previous research (Jackson, Smith, & Conner, 2003; Lowe, Eves, & Carroll, 2002; Norman, Conner, & Bell, 2000). Perhaps because total physical activity includes moderate activity that can be acquired through lifestyle activities rather than “exercise,” it is less likely to be associated with intention, which may connote the formation of a specific plan, rather than incidental activity, to respondents.

The existence of an independent association between self-efficacy and TLTA2 in the absence of an association between intention and activity requires explanation. One possibility is that the specific conditions described by barriers self-efficacy items conjure up the same schemas as those accessed during recall of physical activity behavior. If the intention items which are expressed more generally fail to link into the same schemas, one would expect them to be associated more weakly, if at all. Further study into this issue might employ the use of intention statements that specify the conditions under which activity is expected to happen. This approach might yield a stronger association between intention and behavior.

One final issue raised by these results is the amount of variance left for explanation beyond that covered by prior exercise. While both total leisure time activity at time one and self-efficacy were significant independent predictors of TLTA2, the inclusion of earlier activity did not add to the explained variance of the model, but captured some of the variance attributed to self-efficacy. Time one measurements were taken in February and time two measurements were taken in June. It is entirely likely that the Social Context Model is predicting seasonal variation in physical activity. If this

is true, the heavy explanatory weight assigned to self-efficacy might well be associated with an increase in outdoor recreational programming and secular activity levels owing to improved weather. In short, those with greater self-efficacy are more likely to increase their activity levels as the weather gets better; hence self-efficacy becomes a predictor of subsequent activity levels.

From a measurement perspective, seasonal variation might be ideally accounted for through a standard adjustment for seasonal differences in participation across geographic regions. In the absence of such measures it might be informative to test for moderation by participation in outdoor activities, as this could well account for causal factors that underlie some of seasonal variation.

Hypothesis Tests

A brief synopsis of hypothesis testing from all studies is presented below. The hypotheses from the first study were all either partially supported or completely supported. The Social Context Model fit the data better than either the Interpersonal Influence or the Type of Influence Models. The fit statistics for the Social Context Model were all acceptable when the model included error covariance terms, but only the SRMR was acceptable from the baseline model. Both discriminant and convergent validity were acceptable for the Social Context Model, as was the internal consistency of the three social context factors.

The factors assessing the social contexts of interpersonal influence were all correlated with the putative psychological mediators self-efficacy and positive anticipated outcomes, and intention. Of these, only home and friend social contexts were

independently associated with these factors, with the home context associated with self-efficacy and positive and negative anticipated outcomes. Friend social context was associated with only self-efficacy and positive anticipated outcomes. In sum, the hypothesis of independent association was partially supported. The hypothesis of complete mediation was only partially supported, as friend, but not home social context was independently associated with intention.

With regard to the prediction of physical activity, the hypothesis of complete mediation of interpersonal influence by psychological factors was supported. Partial support was found for the hypothesis of independent association between self-efficacy and intention with physical activity, with self-efficacy, but not intention being independently associated with physical activity. A summary of hypothesis testing is found in Table 7.1.

Table 7.1 Summary of hypothesis tests.

Hypothesis	Finding
Regarding the measurement of interpersonal influence	
A three factor measurement model based on the factors “home social context,” “work social context,” and “friend social context” will fit the data better than a single factor model based on “interpersonal influence” or a two factor model based on “social support” and the “descriptive norm.”	Supported
The three factor model RMSEA values will be below .05.	Partially supported – only true with error terms covaried.
The three factor model will have SRMR values below .10.	Supported
The three factor model will have CFI values above .90.	Partially supported – only true with error terms covaried.
The three factor model will have inter-factor correlations less than .85	Supported
The scales from the three factor model will have Chronbach alpha values in excess of .70.	Supported
Regarding the relationships between interpersonal influence factors and intention	
Social context factors assessing interpersonal influence will be positively and independently associated with self-efficacy and anticipated outcomes.	Partially supported – work social context correlated but not independently associated with self-efficacy or anticipated outcomes
Teasing will be negatively and independently associated with self-efficacy and positive anticipated outcomes and positively and independently associated with negative anticipated outcomes.	Partially supported – teasing correlated but not independently associated with self-efficacy or anticipated outcomes. It is positively and independently associated with negative anticipated outcomes.
Factors assessing interpersonal influence will not be independently associated with intention.	Partially supported – Friend social context independently associated with intention
Regarding the prediction of physical activity behavior	
The association between interpersonal influence and energy expenditure from leisure time physical activity will be completely mediated by psychological factors.	Supported
Intention and self-efficacy will be positively and independently associated with physical activity	Partially supported – Only self efficacy independently associated with physical activity

Theory

The Integrated Behavioral Model¹⁴ (see Figure 7.1) has brought together ideas from the NIMH conference (Fishbein, 1995) with notions of salience and habit into a

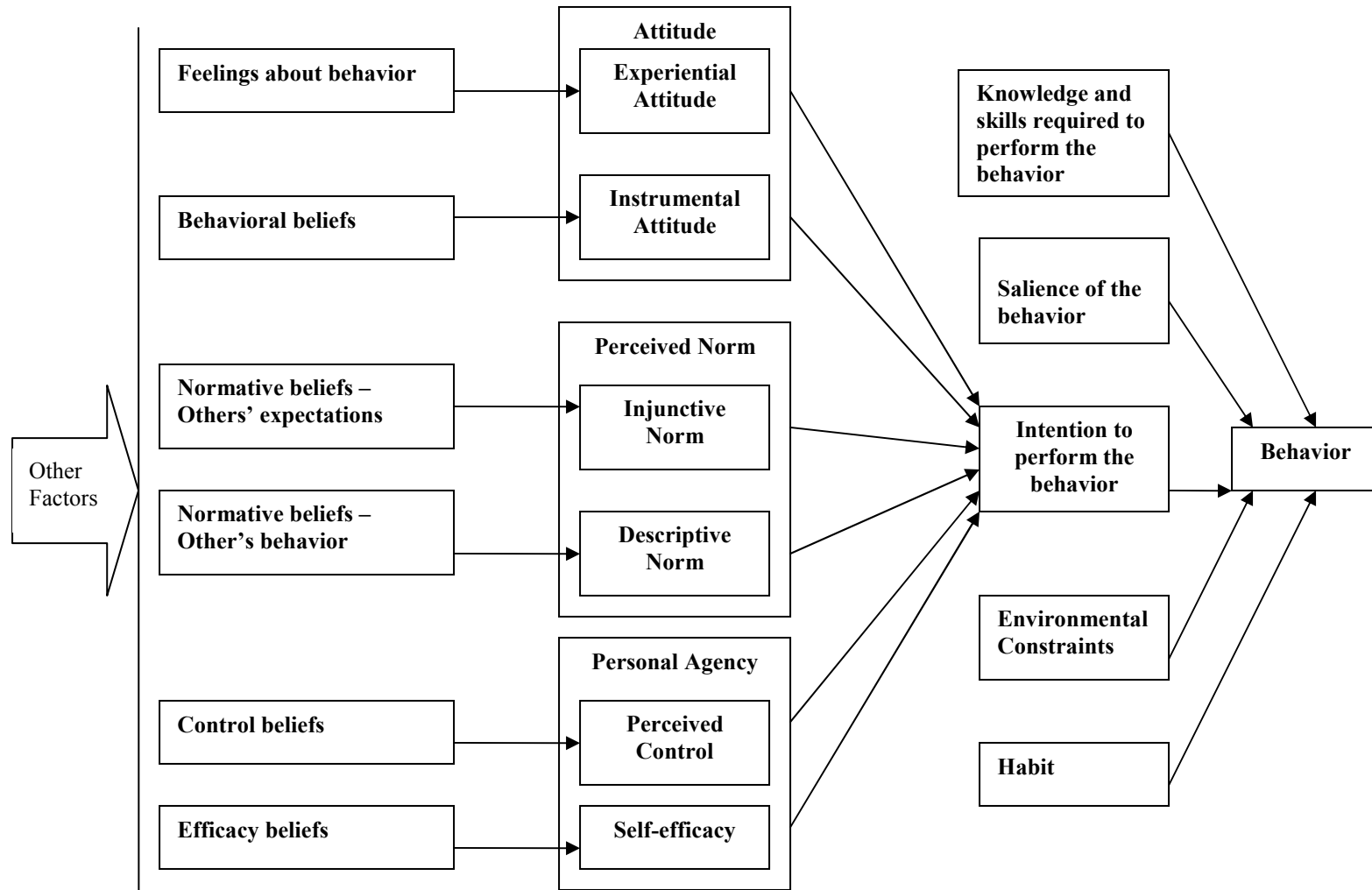


Figure 7.1. The Integrated Behavioral Model (Montano and Kasprzyk, 2008).

framework greatly resembling an enhanced Theory of Planned Behavior (Ajzen, 1991; Ajzen, 2002). This development represents a number of advances. It includes an updated version of TPB concepts including self-efficacy, descriptive norm, and differentiated dimensions of attitude – experiential and instrumental. The inclusion of salience accounts for part of the error term resulting from the prediction of behavior by intention. Habit may also improve the prediction of behavior beyond that afforded by intention. The notions of skills, knowledge, and environmental constraints come to this model from Social Cognitive Theory (Bandura, 1986) via the NIMH conference findings. On the whole, the IBM should improve prediction of behavior when compared to the results of the TPB or a model representing the NIMH conference findings. This paper will present a model that offers a number of improvements beyond the Integrated Behavioral Model and points to the findings of this paper as evidence for some, but not all, of the propositions implicit this new model.

The Theory of Reasoned Action (Ajzen & Fishbein, 1980) began as an iterative model with a feedback loop. The testing of this model and its more highly evolved companion, the TPB, in physical activity settings did not often employ data or statistical models that accounted for this aspect of the theory. Adjustments to the original TRA (the addition of perceived behavioral control and descriptive norm) have not captured the importance of the iterative process and have, therefore, failed to substantially improve the model. Drawing heavily on the TPB, the IBM is a cross sectional model with little reflection of a dynamic processing of information as reflected by feedback. Consequently, it does not specify by causal relationship the impact of learning over time.

It also fails to account explicitly for the impact of social factors on the psychological factors in the model. These shortcomings result in insensitivity to the factors that shape attitudes and agency. This argument will document this generalization with two findings from the present research. It will follow with the presentation and explanation of an alternative model for the explanation of health behavior.

One of the primary findings of the study of the SCMI is that the relationships between social context factors and intention are either partly or completely mediated by self-efficacy and intention (Kline, 2005). This finding can be interpreted as the influence of social contexts being through psychological mediators, a point that appears to be lost in statistical models of the TPB and that may also come to characterize tests of the IBM. Statistical models have this weakness because the theoretical models on which they are based do not *specify* an alternative formulation and researchers have tended to stay rather close to the Theory of Planned Behavior model.

Rovniak and colleague's structural equation model based on social cognitive constructs²⁰ suffers less from this problem than do typical TPB studies. Rovniak and associates model social support as prior to self-efficacy, which is prior to goals and outcome expectations. This approach allows for distinctions to be drawn between experience and consequence within the analytical model. It is one conclusion of the current study that both the theoretical model and statistical models derived from it should specify interpersonal influence as prior to psychological mediators of the interpersonal influence – intention relationship.

A second finding in this study that documents the importance of accounting for an iterative process regards the association between the disturbance terms for self-efficacy and anticipated outcomes. Several equivalent mathematical models were considered as possible explanations for this relationship. These included anticipated outcomes as a putative cause of self-efficacy, self-efficacy as a cause of anticipated outcomes, and mutual causation, which was successfully modeled by imposing an equality constraint on the regression coefficients. All of these approaches miss the point – the correlated disturbance term represents a *common cause*⁸ that accounts for at least some of the error in the predictions of self-efficacy and anticipated outcomes.

Over time people who found themselves able to participate in physical activity with regularity became more likely to experience its benefits. Those who valued highly the benefits of physical activity in the beginning may have persisted longer in developing a successful program of regular physical activity, thus enhancing their self-efficacy for participation. It is proposed here that post behavioral evaluations feed information back into subsequent assessments of self-efficacy and anticipated outcomes.

This feedback pattern can be modeled in cross sectional models as correlated disturbance terms, as done here. It can be represented in longitudinal models by including assessments of specific exercise experiences (success and benefit - affective or instrumental) and modeling these as prior to later assessments of self-efficacy and anticipated outcomes.

Moderation test results offer tentative support for this explanation. The correlation between the disturbance terms for self-efficacy and anticipated outcomes was

stronger for older respondents and for those who were not obese. These two groups of people have at least one thing in common – the potential to have developed a more elaborated understanding of the outcomes of attempts to participate in physical activity behavior. In the former case, greater age provided more opportunities for performing the behavior, evaluating the experience, and making associations. In the latter case, obesity is associated with lower levels of physical activity. Hence respondents who are not obese are likely to have had more opportunities for post-activity evaluation.

One problem that rears its head in health behavior theory testing is that many studies are not grounded in a model that accounts for the broadest range of determinants and instead favor cognitively oriented models. Given the growing interest in developing structural interventions that facilitate healthful behavioral choices, this is a situation that is due to change. The IBM includes habit as a proximal behavioral determinant, which provides some analytical leverage in the arena of non-cognitive behavior. The problem is not so much in the inclusion of variables, however, as in the failure to specify a mechanism of behavior that serves as a guiding principle around which the myriad concerns of behavior can be organized. Kitchen sink models may explain more variance than more elegant ones, but they fail to verify a causal process unless it is carefully specified.

William Powers presented Perception Control Theory in 1973. The mechanism described in this work has been applied by Carver and Scheier to health behavior (Carver & Scheier, 1998; Carver, 1998). What follows is a brief introduction to Perception Control Theory with extensions that account for complexity in circumstance and for

learning. The proximal causal factors identified in this extended version of perception control theory are then integrated with factors from the current study. Macro-social factors provide further context for a comprehensive analysis of health behavior issues.

Powers proposed that people's behavior is driven by environmental stimuli which are discrepant from "reference signals" for those stimuli (Powers, 1973). The reference signals are stored in the central nervous system and may vary in level of processing from reflex arcs that protect the body from physical danger to perceptions of complex social situations that require heavy cognitive processing. When stimuli are detected that are not congruent with reference signals, control programs (behavior) are enacted that impact the environment and may or may not modify the incoming stimuli until they are congruent with reference signals.

Ripperger-Suhler (2007) proposed that the ability to enact successful control programs was a function of the balance between available resources and environmental demands, two concepts that are closely mirrored by concepts (skills and impediments) from the IBM. He further proposed that as the resource/demand ratio increased, the deviation in stimulus from the reference signal tolerated by the organism without initiating behavior would decrease. As the resource/demand ratio decreased, the organism would tolerate an increasingly large deviation from the reference signal before initiating behavior to control variables for which broader tolerance is permitted by genetic programming. The extreme of the latter case would be depression, in which a generalized perceived failure to control environmental stimuli results in the tolerance of many "out of range" values for a wide variety of stimuli.

As in the IBM, salience is seen as a proximal determinant of behavior. Genetically determined salience is a factor that reflects the body's need to apply either a homeostatic (narrow tolerance) or allostatic (wide tolerance) approach to regulation. Allostatic variables are generally seen as supportive of the narrow tolerance required for maintenance of variables most critical to life functions (McEwen & Lasley, 2002). Experientially determined salience is captured by the construct intention. Intention is determined largely by self-efficacy and anticipated outcomes, as has been reported many times, including this study. The development of experientially determined salience was addressed by the discussion of the correlated disturbance term, seen here as an artifact of the result of ongoing evaluation of behavioral performance.

Socialization processes provide some information that contributes to self-efficacy and anticipated outcomes beliefs (Bandura, 1986; Rimal, 2003; DiLorenzo et al., 1998). These beliefs are also shaped by feedback from behavioral evaluation, as previously mentioned. Socialization processes also shape resources through the development of control programs (behaviors) that employ various sets of information, physical resources such as strength, endurance, appearance, and the social resources of capital and status (social position). Socialization processes are driven by social norms that impact people with different personal characteristics differentially. The fundamental findings in this study regarding the mediation of interpersonal influence by psychological mediators bear directly on this proposition. Interestingly, the poor fit of the social support – companionship for activity indicators in the Social Context Model suggests that perhaps at least some aspects of social support operate differently than the descriptive norm. It is

possible that companionship, for example, operates as a resource so potent that it should be considered as a proximal determinant of behavior. Given the number of studies which found an independent association between physical activity and social support (Courneya et al., 2000; Marquez & McAuley, 2006), this might be a reasonable conclusion to draw at this point in the study, although far from a final one.

Social stratification or inequality shapes the degree to which norms vary by personal characteristics and the extent to which socialization processes provide people with differential access to resources. Socialization processes reinforce stratification and, consequently, the norms upon which they are based (Kohn, 1989). This feedback loop involving stratification, norms, and socialization processes serves as an attractor (Juarrero, 1999) that magnifies its effect over the lifespan of a social system. The consequence of this feedback loop could be an increasing disparity in the resource/demand ratio across social strata and over time, as well an increase in the disparity of health outcomes across social strata.

A third feedback loop relates behavioral evaluation to socialization processes. Socialization is an ongoing dynamic process by which people come to understand their places in the social system in part through the outcomes of their behavioral attempts. Persistent success or failure can lead to reevaluation and the establishment of new identities (Kaplan & Johnson, 2001). Lorentzen and associates (2009) describe the process by which they attempted to manipulate identity and their finding that identity did in fact mediate between intervention actions and changes in physical activity behavior.

In the Perception Control Model of Health Behavior, identity is an aspect and an outcome of the socialization process, but is not differentiated from it in the figure.

Resnicow and Vaughn (2006) call for models of health behavior that embrace principles of complex systems. They point to one issue that is particularly relevant to this discussion – “...complex systems involve multiple component parts that interact in a nonlinear fashion...” (2006:1). They note that health behavior theories tend to be linear in nature, even though behavior is not necessarily so. They describe unexplained variance as perhaps being part of the chaotic component in behavioral determination. Consider the Perception Control Model of Health Behavior in Figure 7.2.

This model presents a complex system that is neither cross sectional nor linear. Its complexity comes from its attempt to integrate biological constructs (sex, age, body composition) with social factors (educational attainment, norms, stratification, socialization), psychological factors (self-efficacy, anticipated outcomes, intention, salience), and behavior. Non-linearity is introduced through feedback loops that are explicitly modeled over time (stratification – socialization) and behavioral evaluation with both self-efficacy and anticipated outcomes as well as socialization. These non-linearities are not necessarily predicted from models that do not account explicitly for feedback and longitudinal processes that *proceed beyond one iteration*.

It is important to note that interventions that embrace this complexity are not beyond the scope of current health promotion understandings. Consider again the “Romsås in Motion” Community Intervention.³⁵ The potential for individual and system

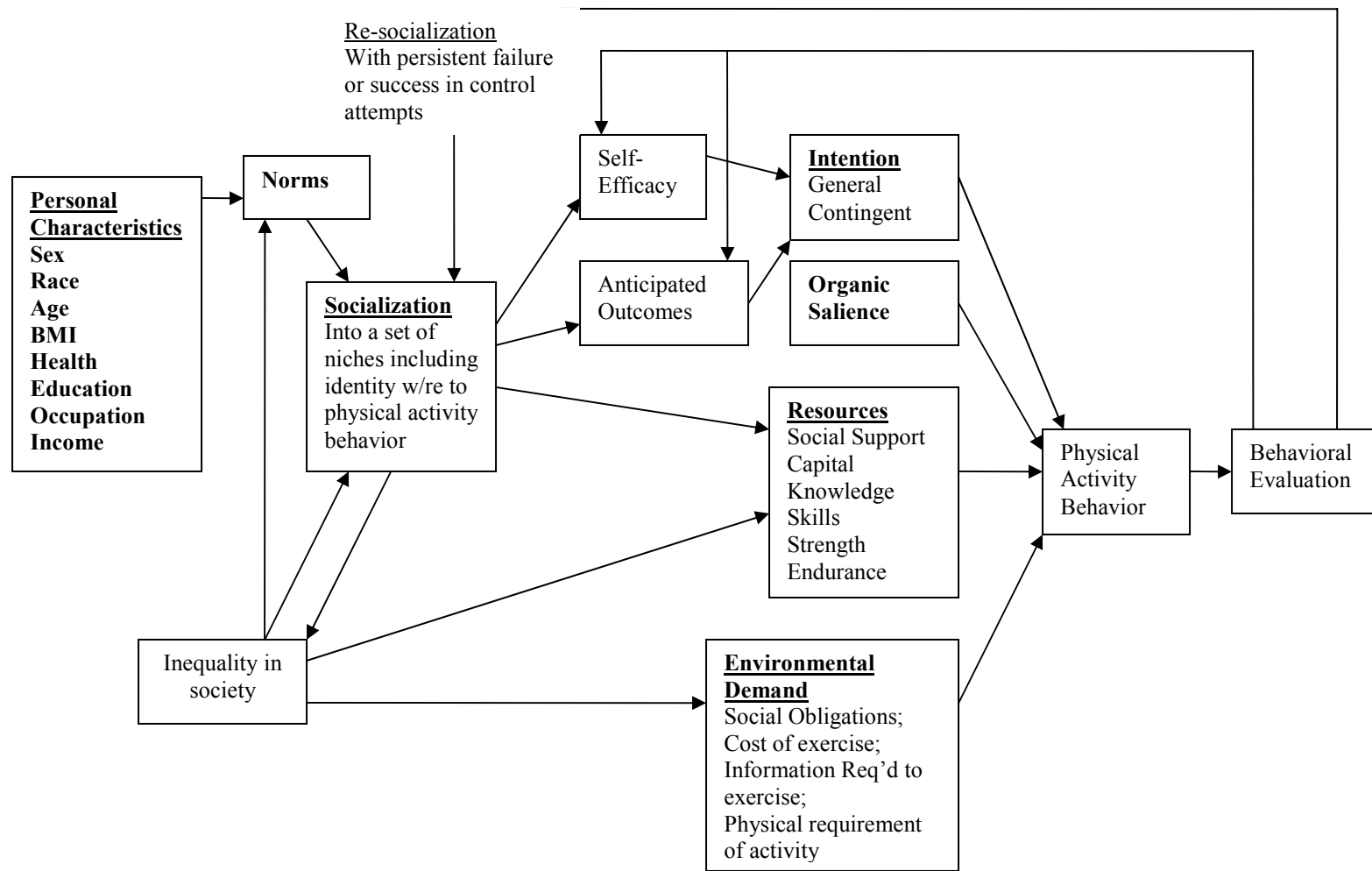


Figure 7.2. The Perception Control Model of Health Behavior

level changes was maximized by purposefully destabilizing both of them simultaneously. While the potential for unintended consequences is greater in this circumstance, the potential for changing health behavior is probably maximized because neither the individual nor the social system retains its full capacity to impose stability on the other. Less ambitious interventions may be doomed to be less effective, as attempts at individual level change run headlong into environments that do not reinforce new behaviors.

Application to Practice

The results of this study provide some estimate of the extent to and means by which the physical activity of adults could be influenced by their interpersonal experiences. This study does not provide data about the most efficacious setting in which to implement physical activity interventions. It does not report on the results of such an intervention. This report does describe the potential for the diffusion of beliefs about physical activity behavior through various social settings. Two recommendations can be made on this basis.

1. Interventions that promote increased self-efficacy through attributional retraining (Försterling, 1985) might help promote physical activity among those with lower levels of education. This would be a two step process in which individuals with over-generalized understandings of why they were or weren't able to establish and maintain regular activity come to make finer distinctions in this regard and then learn how to overcome barriers to their activity.

2. Focus on other forms of environmental facilitation of exercise. The interpersonal factors explored in this study account for a significant but small part of the variance in the psychological mediators. It follows that interpersonal influence should be part of a comprehensive program which seeks to impact behavioral determinants across the socio-ecological spectrum. Figure 7-3 depicts the synergistic impact that could be accomplished through multi-level intervention on the order of the “Romsås in Motion” program (Lorentzen et al., 2009).

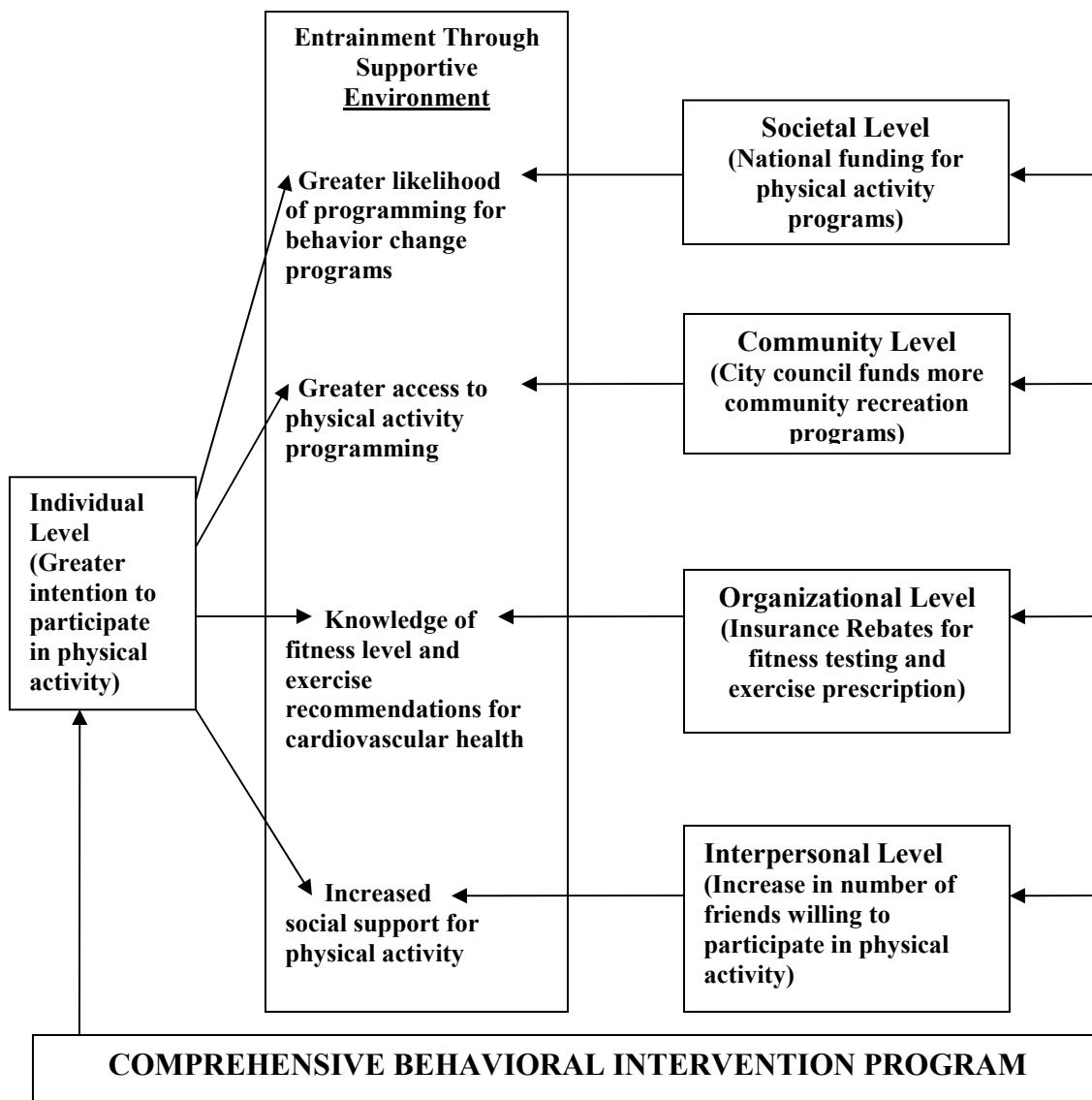


Figure 7.3. The synergistic impact of multi-level interventions

Limitations

The data for this study were drawn from an online survey. Problems with the physical activity data resulted in the loss of 165 cases for the final analysis of TLTA2 including TLTA1. This is clear indication that the measurement tools need to be adjusted to realize the validity they were found to have in face to face administrations (Bull & Armstrong, 2006). Survey data are also prone to problems with various response set patterns including social desirability. Structural equation models are based on correlational analysis and do not provide sufficient evidence of causation in their own right (Kline, 2005). Even longitudinal models with a high degree of plausibility are subject to distortions from unobserved variance, which may render conclusions about relationships erroneous.

While the samples on which the models were tested were similar to both the worksite population and the total sample from which they were created, the failure to replicate most moderation results across the samples raises questions about systematic differences between them. For this reason, unreplicated moderation results should be interpreted with caution.

The lack of sufficient sample variety to test for moderation by gender and by race/ethnicity reduces the certainty and clarity of the results. Given the association between these factors and activity levels (Centers for Disease Control and Prevention, 2007), it is reasonable to expect that more nuanced results would have been produced if these moderation analyses had been performed. The same concern applies to a stages of change analysis (Prochaska, Redding, & Evers, 2008). Moderation testing by stages of

change could have produced results with greater theoretical specificity, as well as more clear application to intervention activities.

Future Research

The findings of this study suggest a number of questions for future research. These include measurement issues, the structure of analytical models, and the testing of results in applied settings.

There are four measurement issues of concern. A large number of cases were lost because of invalid responses to the physical activity items. This problem was not evident in limited preliminary testing of the instrument, but there is clearly great need to refine the delivery system to reduce the number of cases lost to what appears to be erroneous data entry.

It may be fruitful to experiment with the measurement of intention. In this study, items included references to the time period (next four months) and the frequency of physical activity (regular), but not the conditions under which it would happen. On the other hand, self-efficacy was associated with TLTA2 when intention was not. One explanation is that self-efficacy items included references to specific conditions under which activity might occur. This might have triggered the same schemas as were recalled when the respondents were recalling their physical activity data. It might be very interesting to specify the conditions under which a person intended to exercise, such as after work, during lunch times, or on weekends. These questions might also tap into the schemas that contain information about specific physical activity instances and, thereby,

lead to responses that are more closely linked to the ways in which physical activity memories are stored.

Social context factors included the social support item referring to having a companion for physical activity, but these items exhibited the worst fit of all items. Less than half of the variance was explained for each companionship indicator and one item cross loaded onto two factors. It may be that this form of social support constitutes an entirely different factor, perhaps a resource that has an independent association with physical activity behavior. It is worth noting that social support was found to have an independent association with physical activity in several cases (Courneya et al., 2000; Marquez & McAuley, 2006).

This study challenged the causal structure that underlies the Theory of Planned Behavior and the Integrated Behavioral Model. Tests of the Social Context Model of Interpersonal Influence reported here found that interpersonal influence was mediated by self-efficacy and anticipated outcomes. This result is worthy of verification in order to establish more clearly actual causal sequence and verify the potential channels through which behavioral determinants such as self-efficacy and anticipated outcomes can be manipulated.

Broader tests of the Perception Control Theory of Health Behavior could explore the relative impacts of various types of resources (knowledge, skills, ability, capital (money), and, perhaps, exchange relationships) on participation in physical activity across different social strata. Coupling resource analysis with evaluations of environmental barriers, such as were mitigated in the “Romsås in Motion” community

intervention (Lorentzen et al., 2009) could produce findings with more of a deterministic robustness. The broad range of factors addressed in the intervention may provide a guidepost for future intervention work. The most successful interventions will likely be those that bring individuals whose psychosocial determinants had been impacted into contact with an environment that is supportive of efforts to initiate and maintain physical activity.

The association between self-efficacy and anticipated outcomes and its moderation by age and education is worthy of further exploration. If this pattern is in fact driven by differences in behavioral evaluations between young and old, on one hand, and those who are and are not obese on the other, the implications of this finding may be crucial in helping those groups with lower reported levels of physical activity (obese and old) recognize and counteract to some degree factors that cause them to experience lower levels of physical activity for less than deterministic reasons.

One final thought regards the use of moderation testing by stages of change for physical activity. This approach could be accomplished in a structural equations framework and might yield very interesting variability in mediation patterns across stages of change. Such information could be used to validate further the stages of change framework and to help to tailor interventions more precisely to the specific target population needs.

APPENDICES

Appendix A: Time 1 Survey as Submitted to Scott & White IRB

Introduction

You are invited to participate in a research project involving a survey on attitudes and habits related to health. The survey should take 10 to 15 minutes to fill out. The questions deal with eating, physical activity, and other health-related thoughts and behavior. This is not connected to the health risk assessment you may have completed last year and is not related to your insurance premiums. This is an independent research survey, and your participation is voluntary.

All of your answers are confidential. Your name will be used only to connect the answers you give on this survey to those from a follow-up survey we will ask you to repeat in June.

The information in this survey will be used for two purposes. First, this information will help us develop health promotion programs that meet your needs. Your answers will help us judge how effective our programs are and what we might do better. Second, researchers from the University of Texas are collaborating with Scott & White researchers to interpret the information in order to improve theories of health behavior.

Your completion of this survey implies your consent to take part in the research. You may withdraw at any time should you choose to discontinue the survey. Again, all comments will be kept anonymous. If you have any questions, you may contact Dr. Jennifer Hays-Grudo at 724-6427.

There are no right or wrong answers to this survey. The best answers you can give should be honest and reflect your actual experiences, thoughts, and feelings.

Once again, thank you for taking the time to complete this survey.

Your Name _____
Your Email Address _____
Your Workplace _____
Today's Date _____

Use your browser's print function to print a copy of this page for your records.

Background Information

1. Including yourself, how many people live in your house? (*Please place a number in each space*).

_____ Adults (18 years of age and older)
_____ Older children (5-17 years of age)
_____ Younger children (under 5 years of age)

2. Gender: Female ☐ Male ☐

3. Age: _____ years

4. Marital Status:

Please check one:

- ☐ Single
- ☐ Married
- ☐ Divorced
- ☐ Separated
- ☐ Widowed

5. Race:

Please check one:

- ☐ White
- ☐ Hispanic/Mexican American
- ☐ Black/African American
- ☐ Asian
- ☐ Other, please specify _____

6. Education: What is the highest year of school you have finished?

- ☐ Grade 8 or less
- ☐ Some high school
- ☐ High school graduate/GED completed
- ☐ Some college
- ☐ College graduate
- ☐ Other (please specify _____)

7. Current Height: _____ ft. _____ inches **Weight:** _____ lbs

8. What is your position at Scott & White? _____

9. How many years have you been working at Scott & White? _____ years

Fruit and Vegetable Consumption

In this section of the survey we will ask you about your fruit and vegetable eating habits. Before you answer the following questions, you need to know that one serving size is equal to:

1 medium fruit or 1/2 cup of cut-up fruit	1/2 cup raw or cooked vegetables
3/4 cup 100% fruit juice	1 cup raw leafy vegetables (e.g., lettuce, spinach)
1/4 cup dried fruit	1/2 cup cooked beans or peas (e.g., lentils, pinto beans)

On average, how many **total servings** of fruits and vegetables do you eat **each day** (including those eaten at work and at home)? _____

On average, how many total servings of fruits and vegetables do you eat **each day at work**?

On average, how many total servings of fruits and vegetables do you eat **each day at home**?

Your plans for Spring

Please rate the accuracy of the following statements.

	Strongly Disagree			Strongly Agree	
	1	2	3	4	5
I plan to eat 5 or more servings of fruits and vegetables most days of the week for the next 4 months.	1	2	3	4	5
I am not likely to eat 5 or more servings of fruits and vegetables most days of the week for the next 4 months.	1	2	3	4	5
I am going to eat 5 or more servings of fruits and vegetables most days of the week for the next 4 months.	1	2	3	4	5

For each item below, please circle the answer that shows how **confident** YOU are about eating fruits and vegetables on a daily basis.

HOW CONFIDENT ARE YOU THAT YOU CAN.	Not at all Confident	Moderately Confident		Extremely Confident	
. . .eat 5 or more servings of fruits and vegetables every day?	1	2	3	4	5
. . .eat fruits and vegetables when you are in a rush?	1	2	3	4	5
. . .eat fruits and vegetables on days when you are at home?	1	2	3	4	5
. . .plan meals with more fruits and vegetables?	1	2	3	4	5
. . .prepare fruits and vegetables so they taste good?	1	2	3	4	5

Please rate how important each of these statements is in your decision of whether to eat fruits and vegetables. In each case, think about how you feel **right now**, not how you have felt in the past or would like to feel.

I THINK.	Not at All Important		Moderately Important		Extremely Important
... it is easy to keep fruits and vegetables on hand at home.	1	2	3	4	5
... eating more fruits and vegetables is easy because my family likes them.	1	2	3	4	5
... eating fruits and vegetables is hard because they are too expensive to buy on a regular basis.	1	2	3	4	5
... eating fruits and vegetables is good because they are healthful foods.	1	2	3	4	5
... eating fruits and vegetables keeps me from getting sick.	1	2	3	4	5

PHYSICAL ACTIVITY

These questions ask you about the times you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, or seeking employment. In answering the following questions, “vigorous intensity activities” are activities that require hard physical effort and cause large increases in breathing or heart rate. “Moderate intensity activities” are activities that require moderate physical effort and causes small increases in breathing or heart rate.

Activity at work

1. Does your work involve vigorous intensity activity that causes large increases

Yes 1

in heart rate like carrying or lifting heavy loads, digging or construction work for

No 2

at least 10 minutes continuously?

2. In a typical week, on how many days do you do vigorous intensity activities

as part of your work? Number of days _____

3. How much time do you spend doing vigorous intensity work on a typical day?

____|____| and ____|____|
hours minutes

4. Does your work involve moderate intensity activities that causes small increases

Yes 1

in breathing or heart rate such as brisk walking or carrying light loads for at least

No 2

10 minutes continuously?

5. In a typical week, on how many days to do you moderate intensity activities as part of your work?. Number of days _____

6. How much time do you spend doing moderate intensity activities on a typical day?

____|____| and ____|____|
hours minutes

Travel to and from places

The next questions exclude the work activities you have already mentioned. These questions will ask you about the usual way you travel to and from places (work, shopping, place of worship.)

7. Do you walk or use a bicycle for at least 10 minutes continuously to get to and from places? Yes 1
No 2

8. In a typical week, on how many days do you walk or use a bicycle for at least 10 minutes continuously to get to and from places?

Number of days _____

9. How much time do you spend walking or bicycling for travel on a typical day?

hours and minutes

Recreational Activities

The next questions exclude the work and travel information that you have already mentioned. These questions will ask you about sports, fitness, and recreational activities including everything from running a marathon to walking around the block when you get home from work.

10. Do you do any vigorous intensity activity that **causes large increases in breathing or heart rate** like running, soccer, basketball, or football for at least 10 minutes continuously? Yes 1 No 2

11. In a typical week, how many days do you do vigorous intensity sports, fitness, or recreational activities.

Number of days _____

12. On a typical day, how much time do you spend doing vigorous intensity sports, fitness, or recreational activities.

____ hours and ____ minutes

13. Do you do any moderate intensity activity that causes a **small increase in breathing or heart rate** such as brisk walking, bicycling, or playing sports in a relaxed way for at least 10 minutes continuously? Yes 1 No 2

14. in a typical week, how often do you do moderate intensity sports, fitness, or recreational activity?

Number of days _____

15. How much time do you spend doing moderate intensity sports, fitness or recreational activity on a typical day?

____ hours and ____ minutes

16. Think about the time you spend sitting and reclining during a typical day. This could include watching television, using a computer, driving a car, playing cards or other activities in which you do not move around other than sleeping.

How much time do you usually spend sitting or reclining on a typical day?

____ hours and ____ minutes

Your plans for Spring

Please rate the accuracy of the following statement.

	Strongly Disagree			Strongly Agree	
Most weeks, I will participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day for the next 4 months.	1	2	3	4	5
I am not likely to participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day for the next 4 months.	1	2	3	4	5
I am going to participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day for the next 4 months.	1	2	3	4	5

Circle a number to indicate how confident you are that you could be physically active and/or exercise in each of the following situations.

How confident are you that you could be physically active or exercise when...	Not at all Confident		Moderately Confident	Extremely Confident	
. . . you are tired?	1	2	3	4	5
. . . you feel you don't have much time?	1	2	3	4	5
. . . your work schedule is tight?	1	2	3	4	5
. . . the weather is bad (rainy, too hot)?	1	2	3	4	5

Please rate how important each of these statements is in your decision of whether to be physically active. In each case, think about how you feel **right now**, *not how you have felt in the past or would like to feel*.

	Not at All Important		Moderately Important		Extremely Important
I would feel more confident if I were regularly physically active.	1	2	3	4	5
Regular physical activity would take too much of my time.	1	2	3	4	5
I would feel less stressed if I were regularly physically active.	1	2	3	4	5
I would feel good about myself if I kept my commitment to be regularly physically active.	1	2	3	4	5
I do not like the way physical activity and exercise makes me feel bad.	1	2	3	4	5
I would have more energy if I were regularly physically active.	1	2	3	4	5

Work Environment

	Strongly Disagree	Disagree	Agree	Strongly Agree
People care about each other at my workplace.	1	2	3	4
I do not feel comfortable at my workplace.	1	2	3	4
My workplace has a positive outlook (for example, staff members enjoy their work, celebrate accomplishments, adopt a “we can” attitude, and bring out the best in each other).	1	2	3	4
Staff members share credit for success.	1	2	3	4
Staff members are rewarded and recognized for their efforts to live a healthy lifestyle.	1	2	3	4
I am comfortable taking time during my lunch hour to exercise.	1	2	3	4
My co-workers eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
My co-workers think I should eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
My co-workers encourage me to eat fruits and/or vegetables at work.	1	2	3	4
My co-workers make fun of people who eat healthily.	1	2	3	4
I eat fruits and vegetables with a co-worker at work.	1	2	3	4
My co-workers talk about being physically active.	1	2	3	4
My co-workers <i>often</i> participate in moderate or vigorous physical activity.	1	2	3	4
My co-workers encourage me <i>to</i> participate in moderate or vigorous physical activity.	1	2	3	4
My co-workers tease me about not being athletic.	1	2	3	4
My co-workers think I should participate in moderate or vigorous physical activity.	1	2	3	4
I participate in physical activity with a co-worker.	1	2	3	4
I am like most of my co-workers.	1	2	3	4

Away from Work

	Strongly Disagree	Disagree	Agree	Strongly Agree
The people I live with eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
The people I live with think I should eat 5 or more servings of fruits and vegetable most days.	1	2	3	4
The people I live with tease me about eating healthily.	1	2	3	4
In my house, we talk about eating fruits and vegetables most days.	1	2	3	4
The people I live with often participate in moderate or vigorous physical activity.	1	2	3	4
The people I live with talk about being physically active.	1	2	3	4
The people I live with tease me about not being athletic.	1	2	3	4
The people I live with encourage me to participate in moderate or vigorous physical activity.	1	2	3	4
I participate in physical activity with a person from my home.	1	2	3	4
I am like most of the people I live with.	1	2	3	4
My friends eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
My friends think I should eat 5 or more servings of fruits and vegetable most days.	1	2	3	4
My friends tease me about eating healthily.	1	2	3	4
My friends and I talk about eating fruits and vegetables.	1	2	3	4
My friends often participate in moderate or vigorous physical activity.	1	2	3	4
My friends talk about being physically active.	1	2	3	4
My friends tease me about not being athletic.	1	2	3	4
My friends encourage me to participate in moderate or vigorous physical activity.	1	2	3	4
I participate in physical activity with one or more of my friends.	1	2	3	4
I am like most of my friends.	1	2	3	4
I see advertisements about eating fruits and vegetables on television, in magazines, or on the internet.	1	2	3	4
I see advertisements about being physically active on television, in magazines, or on the internet.	1	2	3	4

Scott & White Attitudes and Habits Related to Health Evaluation *Time 2*

[The following questions will be added to the survey at time 2. All questions will be repeated from the time 1 survey so the effect of the wellness program on employee attitudes and behaviors can be estimated]

Supervisor Behavior

Please rate the following statements about your worksite supervisor.

	Strongly Disagree	Disagree	Agree	Strongly Agree
My supervisor was a role model for physical activity.	1	2	3	4
My supervisor encouraged workers to participate in physical activity.	1	2	3	4
My supervisor created opportunities for workers to participate in physical activity.	1	2	3	4
My supervisor asked me if I was participating in the Biggest Loser or in Walk Across Texas.	1	2	3	4

Worksite Wellness Coordinator Activity***Coordinator Estimate***

The coordinators will be asked to provide a complete catalogue of health promotion activities for the period February - May 2008.

Employee Estimate

Employees will be asked a series of questions that address whether or not they received communication and/or knew the content of communication attempts by the worksite wellness coordinator.

Sample Items (actual items to be determined from worksite wellness coordinators reports of health promotion activities)

I was told when the Walk Across Texas Program started.

I knew how to report my physical activity to my team captain for Walk Across Texas.

I knew when to sign up for Biggest Loser.

Response Pattern

From 1 (Strongly Disagree) to 4 (Strongly Agree)

Appendix B: Time 2 Survey

Scott & White Employee Attitudes and Habits Related to Health Evaluation *Time 2*

The survey will be administered via ZOOMERANG, an online survey service. This document is divided into pages that match the pagination in the online document.

Page	Content
2	Introduction/Informed Consent
3	Background Information
4	Fruit and Vegetable Consumption
5	Intentions for Fruit and Vegetable Consumption for Summer
6	Self Efficacy for Fruit and Vegetable Consumption
7	Decisional Balance for Fruit and Vegetable Consumption
8-10	Physical Activity
11	Intentions for Physical Activity for Summer
12	Self Efficacy for Physical Activity
13	Decisional Balance for Physical Activity
14	Work Environment
15	Non-Work Environment
16	Wellness Program Participation
17	Communication re Wellness Program
18	Community Garden Questions

Pages in red require IRB review. Changed or new items are printed in red on the marked pages.

Most of these are wording changes, especially re tense of verbs.

Introduction

Thank you for participating in the first survey of health behaviors and attitudes in February of this year. You are now invited to participate in the follow-up survey. Upon completion of this survey, you will be automatically entered in a drawing for a chance to win one of 30 iPods. The drawing for iPods will be held at the conclusion of data collection which is expected to end during the week of June 16-20.

The survey should take about 15 minutes to fill out. As with the first survey, the questions deal with eating, physical activity, and other health-related thoughts and behavior. This is not connected to the health risk assessment you may have completed last year and is not related to your insurance premiums. This is an independent research survey, and your participation is voluntary.

All of your answers are confidential. Your name will be used only to connect the answers you give on this survey to those from the survey you responded to in February. The information in this survey will be used for two purposes. First, this information will help us develop health promotion programs that meet your needs. Your answers will help us judge how effective our programs are and what we might do better. Second, researchers from the University of Texas are collaborating with Scott & White researchers to interpret the information in order to improve theories of health behavior.

Your completion of this survey implies your consent to take part in the research. You may withdraw at any time should you choose to discontinue the survey. Again, all comments will be kept anonymous. If you have any questions, you may contact Dr. Jennifer Hays-Grudo at 724-6427.

There are no right or wrong answers to this survey. The best answers you can give should be honest and reflect your actual experiences, thoughts, and feelings.

Once again, thank you for taking the time to complete this survey.

Your Name _____
Your Email Address _____
Your Workplace _____
Today's Date _____

Use your browser's print function to print a copy of this page for your records.

Background Information

1. Including yourself, how many people live in your house? (*Please place a number in each space*).

_____ Adults (18 years of age and older)
_____ Older children (5-17 years of age)
_____ Younger children (under 5 years of age)

2. Gender: Female ☐ Male ☐

3. Age: _____ years

4. Marital Status:

Please check one:

- ☐ Single
- ☐ Married
- ☐ Divorced
- ☐ Separated
- ☐ Widowed

5. Race:

Please check one:

- ☐ White
- ☐ Hispanic/Mexican American
- ☐ Black/African American
- ☐ Asian
- ☐ Other, please specify _____

6. Education: What is the highest year of school you have finished?

- ☐ Grade 8 or less
- ☐ Some high school
- ☐ High school graduate/GED completed
- ☐ Some college
- ☐ College graduate
- ☐ Other (please specify _____)

7. Current Height: _____ ft. _____ inches **Weight:** _____ lbs

8. What is your position at Scott & White? _____

9. How many years have you been working at Scott & White? _____ years

Fruit and Vegetable Consumption

In this section of the survey we will ask you about your fruit and vegetable eating habits. Before you answer the following questions, you need to know that one serving size is equal to:

1 medium fruit or 1/2 cup of cut-up fruit	1/2 cup raw or cooked vegetables
3/4 cup 100% fruit juice	1 cup raw leafy vegetables (e.g., lettuce, spinach)
1/4 cup dried fruit	1/2 cup cooked beans or peas (e.g., lentils, pinto beans)

On average, how many **total servings** of fruits and vegetables did you eat **each day from February through May of this year** (including those eaten at work and at home)?

On average, how many total servings of fruits and vegetables did you eat **each day at work**?

On average, how many total servings of fruits and vegetables did you eat **each day at home**?

Your plans for Summer

Please rate the accuracy of the following statements.

	Strongly Disagree			Strongly Agree	
I plan to eat 5 or more servings of fruits and vegetables most days of the week during the next 3 months.	1	2	3	4	5
I am not likely to eat 5 or more servings of fruits and vegetables most days of the week during the next 3 months.	1	2	3	4	5
I am going to eat 5 or more servings of fruits and vegetables most days of the week during the next 3 months.	1	2	3	4	5

For each item below, please circle the answer that shows how **confident** YOU are about eating fruits and vegetables on a daily basis.

HOW CONFIDENT ARE YOU THAT YOU CAN. . . .	Not at all Confident		Moderately Confident		Extremely Confident
. . .eat 5 or more servings of fruits and vegetables every day?	1	2	3	4	5
. . .eat fruits and vegetables when you are in a rush?	1	2	3	4	5
. . .eat fruits and vegetables on days when you are at home?	1	2	3	4	5
. . .plan meals with more fruits and vegetables?	1	2	3	4	5
. . .prepare fruits and vegetables so they taste good?	1	2	3	4	5

Please rate how important each of these statements is in your decision of whether to eat fruits and vegetables. In each case, think about how you feel **right now**, not how you have felt in the past or would like to feel.

I THINK. . . .	Not at All Important		Moderately Important	Extremely Important	
... it is easy to keep fruits and vegetables on hand at home.	1	2	3	4	5
... eating more fruits and vegetables is easy because my family likes them.	1	2	3	4	5
... eating fruits and vegetables is hard because they are too expensive to buy on a regular basis.	1	2	3	4	5
... eating fruits and vegetables is good because they are healthful foods.	1	2	3	4	5
... eating fruits and vegetables keeps me from getting sick.	1	2	3	4	5
... eating fruits and vegetables keeps me from getting sick.	1	2	3	4	5

PHYSICAL ACTIVITY

These questions ask you about the times you spend doing different types of physical activity in a typical week **beginning in February and ending in May** of this year.

Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spent doing work. Think of work as the things you had to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, or seeking employment. In answering the following questions, “vigorous intensity activities” are activities that require hard physical effort and cause large increases in breathing or heart rate. “Moderate intensity activities” are activities that require moderate physical effort and causes small increases in breathing or heart rate.

Activity at work

1. Did your work involve vigorous intensity activity that causes large increases in heart rate like carrying or lifting heavy loads, digging or construction work for at least 10 minutes continuously?

Yes 1

No 2

2. In a typical week, on how many days did you do vigorous intensity activities as part of your work? Number of days _____

3. How much time did you spend doing vigorous intensity work on a typical day?

____|____| ____|____|
hours and minutes

4. Did your work involve moderate intensity activities that causes small increases in breathing or heart rate such as brisk walking or carrying light loads for at least 10 minutes continuously?

Yes 1

No 2

5. In a typical week, on how many days did you do moderate intensity activities as part of your work? Number of days _____

6. How much time did you spend doing moderate intensity activities on a typical day?

____|____| ____|____|
hours and minutes

Travel to and from places

The next questions exclude the work activities you have already mentioned. These questions will ask you about the usual way you traveled to and from places between February and May of this year (work, shopping, place of worship.)

7. Did you walk or use a bicycle for at least 10 minutes continuously to get to and from places?

Yes 1

No 2

8. In a typical week, on how many days did you walk or use a bicycle for at least 10 minutes continuously to get to and from places?

Number of days _____

9. How much time did you spend walking or bicycling for travel on a typical day?

____|____|
hours

and

____|____|
minutes

Recreational Activities

The next questions exclude the work and travel information that you have already mentioned. These questions will ask you about sports, fitness, and recreational activities including everything from running a marathon to walking around the block when you get home from work.

10. Did you do any vigorous intensity activity that **caused large increases in breathing or heart rate** like running, soccer, basketball, or football for at least 10 minutes continuously?

Yes 1

No 2

11. In a typical week, how many days did you do vigorous intensity sports, fitness, or recreational activities.

Number of days _____

12. On a typical day, how much time did you spend doing vigorous intensity sports, fitness, or recreational activities.

____|____| and ____|____|
hours minutes

13. Do you do any moderate intensity activity that caused a **small increase in breathing or heart rate** such as brisk walking, bicycling, or playing sports in a relaxed way for at least 10 minutes continuously?

Yes 1

No 2

14. In a typical week, how often did you do moderate intensity sports, fitness, or recreational activity?

Number of days _____

15. How much time did you spend doing moderate intensity sports, fitness or recreational activity on a typical day?

____|____| and ____|____|
hours minutes

16. Think about the time you spent sitting and reclining during a typical day. This could include watching television, using a computer, driving a car, playing cards or other activities in which you did not move around other than sleeping.

How much time did you usually spend sitting or reclining on a typical day?

____|____| and ____|____|
hours minutes

Your plans for Summer

Please rate the accuracy of the following statement.

	Strongly Disagree			Strongly Agree	
Most weeks, I will participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day during the next 3 months.	1	2	3	4	5
I am not likely to participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day during the next 3 months.	1	2	3	4	5
I am going to participate in moderate or vigorous physical activity at least 5 days per week for at least 30 minutes per day during the next 3 months.	1	2	3	4	5

Circle a number to indicate how confident you are that you could be physically active and/or exercise in each of the following situations.

How confident are you that you could be physically active or exercise when...	Not at all Confident		Moderate ly Confident	Extremely Confident	
	1	2		4	5
. . . you are tired?	1	2	3	4	5
. . . you feel you don't have much time?	1	2	3	4	5
. . . your work schedule is tight?	1	2	3	4	5
. . . the weather is bad (rainy, too hot)?	1	2	3	4	5
. . . you are in a bad mood	1	2	3	4	5

Please rate how important each of these statements is in your decision of whether to be physically active. In each case, think about how you feel **right now**, *not how you have felt in the past or would like to feel*.

	Not at All Important	Moderately Important		Extremely Important	
I would feel more confident if I were regularly physically active.	1	2	3	4	5
Regular physical activity would take too much of my time.	1	2	3	4	5
I would feel less stressed if I were regularly physically active.	1	2	3	4	5
I would feel good about myself if I kept my commitment to be regularly physically active.	1	2	3	4	5
I do not like the way physical activity and exercise makes me feel bad.	1	2	3	4	5
I would have more energy if I were regularly physically active.	1	2	3	4	5

Work Environment

Please indicate if to what extent you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
People care about each other at my workplace.	1	2	3	4
I do not feel comfortable at my workplace.	1	2	3	4
My workplace has a positive outlook (for example, staff members enjoy their work, celebrate accomplishments, adopt a “we can” attitude, and bring out the best in each other).	1	2	3	4
Staff members share credit for success.	1	2	3	4
Staff members are rewarded and recognized for their efforts to live a healthy lifestyle.	1	2	3	4
I am comfortable taking time during my lunch hour to exercise.	1	2	3	4
My co-workers eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
My co-workers think I should eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
My co-workers encourage me to eat fruits and/or vegetables at work.	1	2	3	4
My co-workers make fun of people who eat healthily.	1	2	3	4
I eat fruits and vegetables with a co-worker at work.	1	2	3	4
My co-workers talk about being physically active.	1	2	3	4
My co-workers <i>often</i> participate in moderate or vigorous physical activity.	1	2	3	4
My co-workers encourage me <i>to</i> participate in moderate or vigorous physical activity.	1	2	3	4
My co-workers tease me about not being athletic.	1	2	3	4
My co-workers think I should participate in moderate or vigorous physical activity.	1	2	3	4
I participate in physical activity with a co-worker.	1	2	3	4
I am like most of my co-workers.	1	2	3	4

Away from Work

Please indicate if to what extent you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
The people I live with eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
The people I live with think I should eat 5 or more servings of fruits and vegetable most days.	1	2	3	4
The people I live with tease me about eating healthily.	1	2	3	4
In my house, we talk about eating fruits and vegetables most days.	1	2	3	4
The people I live with often participate in moderate or vigorous physical activity.	1	2	3	4
The people I live with talk about being physically active.	1	2	3	4
The people I live with tease me about not being athletic.	1	2	3	4
I have a pet that needs to be walked every day.	1	2	3	4
The people I live with encourage me <i>to</i> participate in moderate or vigorous physical activity.	1	2	3	4
I participate in physical activity with a person from my home.	1	2	3	4
I am like most of the people I live with.	1	2	3	4
My friends eat 5 or more servings of fruits and vegetables most days.	1	2	3	4
My friends think I should eat 5 or more servings of fruits and vegetable most days.	1	2	3	4
My friends tease me about eating healthily.	1	2	3	4
My friends and I talk about eating fruits and vegetables.	1	2	3	4
My friends often participate in moderate or vigorous physical activity.	1	2	3	4
My friends talk about being physically active.	1	2	3	4
My friends tease me about not being athletic.	1	2	3	4
My friends encourage me to participate in moderate or vigorous physical activity.	1	2	3	4
I participate in physical activity with one or more of my friends.	1	2	3	4
I am like most of my friends.	1	2	3	4
I see advertisements about eating fruits and vegetables on television, in magazines, or on the internet.	1	2	3	4
I see advertisements about being physically active on television, in magazines, or on the internet.	1	2	3	4

Scott & White Attitudes and Habits Related to Health Evaluation
Questions asked at Time 2 only

Spring Wellness Programming

(all yes-no responses)

These questions relate to your experiences with wellness programming at Scott & White this past Spring.

Did you participate in...

... the Community Wellness Half Marathon Race and Relay, 5K Race, and 1-mile Fun Run? Yes
No

... Biggest Loser? Yes
No

... Weight Watchers Class? Yes
No

... Yoga Class? Yes
No

... Walk Across Texas? Yes
No

Have you visited the wellness page on the Scott & White website? Yes
No

Did you try any of the healthy recipes on the wellness page? Yes
No

Supervisor Behavior

Please indicate if to what extent you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
My supervisor was a role model for physical activity.	1	2	3	4
My supervisor encouraged workers to participate in physical activity.	1	2	3	4
My supervisor created opportunities for workers to participate in physical activity.	1	2	3	4
My supervisor asked me if I was participating in the Biggest Loser, Walk Across Texas, or other wellness activities.	1	2	3	4

These questions relate to communication regarding spring wellness programming at Scott & White.

Did you receive the newsletters for Walk Across Texas?	Yes
	No
Did you see the story about Biggest Loser on KCEN TV?	Yes
	No
Did you know there is a bicycle club at Scott & White?	Yes
	No
Did you see News at Noon advertisements for ...	
Biggest Loser?	Yes
	No
Yoga Class?	Yes
	No
The Community Wellness Half Marathon Race and Relay,	Yes
5K Race, and 1-mile Fun Run?	No
Weight Watchers Class?	Yes
	No
Walk Across Texas?	Yes
	No

Community Garden Questions

Scott & White wants your opinion on the feasibility of establishing a community garden on-site, tended by staff members, during their non-work hours.

1. Would you be interested in sharing a community garden plot with __# (?) other employees?

- a. Very interested
- b. Somewhat interested
- c. Not at all interested

2. If you shared a plot, how many hours/week do you think you would spend there during the growing season?

- a. More than 8
- b. 5-7
- c. 2-4
- d. less than 2

Please indicate how much you agree with the following statements...

	Strongly Disagree	Disagree	Agree	Strongly Agree
Having a garden plot at Scott & White would help reduce my stress level.	1	2	3	4
Having a garden plot at Scott & White would make me happier about being at work.	1	2	3	4
Having a garden plot at Scott & White would help me eat more fruits and vegetables.	1	2	3	4
By providing garden space Scott & White would show me that it cares about me.	1	2	3	4
Sharing a garden plot with my co-workers would help me become more friendly with them.	1	2	3	4
Working on a garden plot with my family would be a nice way to spend some time together.	1	2	3	4

Appendix C: Scott & White IRB Approval



Scott & White Institutional Review Board
Federalwide Assurance #FWA00003358
IRB Registration #IRB00000706

Notification of IRB Action

To: Jennifer Hays-Grudo cc: John Coppin, B.S.
Ken Ripperger-Suhler
Grants Administration Office

Project ID: 081440

Title: Scott & White Employee Attitudes and Habits Related to
Health Evaluation

Level of Review: Expedited
Expedited Review Category: 45 CFR 46.110(b)(1)(7)

Date of Action: 1/25/2008

Type of Action: Approval

Approval period: 1/25/2008 to 1/24/2009

Continuing review
deadline: 11/28/2008*

***You are responsible for ensuring IRB approval is obtained for the continuation of your project by submitting the required progress report and supporting documentation by the continuing review deadline.**

Items reviewed:

1. Initial Review Submission Form, Version
2. Review Response Submission Form, Version
3. Protocol dated 01/25/2008, Version 1.1
4. Advertisements for Study Participation dated 01/25/2008, Version 1.2*
5. Survey dated 01/25/2008, Version 1.2*
6. Investigator Bio: Jennifer Hays-Grudo
7. Sub-Investigator Bio: John David Coppin
8. Research Assistant/Sub-Investigator Bio: Ken Ripperger-Suhler

(*Documents modified by the IRB for approval)

The IRB has waived the requirement for documentation of informed consent based on 45 CFR 46.117 (c). Furthermore, federal regulations related to the protection of individually identifiable health information do not apply to the activity described.

Investigator Responsibilities:

- Conduct the informed consent process without coercion or undue influence, while giving subjects sufficient time to consider participation in the research
- Conduct the study according to the currently approved protocol, institutional policies, and all applicable regulations
- Obtain approval from the IRB of any changes in the research prior to implementation except where necessary to eliminate apparent immediate hazards to human subjects. Such urgent changes must be reported to the IRB within five (5) working days
- Personally supervise or conduct the research and ensure appropriate delegation of tasks
- Maintain complete and accurate study records and make them available for inspection
- Notify the IRB Office of any external inspections of the research
- Report unexpected adverse outcomes to the IRB within five (5) working days of knowledge of each occurrence
- Assume responsibility for initial and continuing review of the research by the IRB

IRB Responsibilities:

- Review and have authority to approve, require modifications in or disapprove all research activities
- Ensure all requirements for approval of research are satisfied in accordance with federal regulations
- Report any serious or continuing non-compliance by investigators to the appropriate institutional officials, the Office for Human Research Protections, the Food and Drug Administration and any other appropriate regulatory agencies
- Suspend or terminate approval of research that is not being conducted in accordance with the IRB's requirements or that has been associated with unexpected serious harm to subjects
- Determine that all criteria for IRB approval of research are met as stipulated in the federal regulations
- Require that information given to subjects as part of informed consent is in accordance with federal regulations
- Conduct continuing review of research at intervals appropriate to the degree of risk but not less than once per year, including the authority to observe or have a third party observe the consent process and research

Signature applied by Stephanie Worley on 01/25/2008 05:02:36 PM CST

Administrator and Authorized Representative of the Scott & White IRB

2401 S. 31st St., Alexander Bldg., Temple, Texas 76508

Phone: 254-724-7773/8393

Fax: 254-724-1710

Appendix D: University of Texas at Austin IRB Approval



OFFICE OF RESEARCH SUPPORT

THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, Texas 78713 (512) 471-8871 -FAX (512) 471-8873
North Office Building A, Suite 5.200 (Mail code A3200)

FWA # 00002030

Date: 05/13/09

PI(s): K G Ripperger-Suhler
Nell H Gottlieb

Department & Mail Code: HEALTH PROM-CATCH PROJ
KINESIOLOGY & HEALTH-BEL

Title: Scott & White Employee Attitudes and Habits Related to
Health Evaluation

IRB APPROVAL – IRB Protocol # 2008-04-0005

Dear: K G Ripperger-Suhler Nell H Gottlieb

In accordance with Federal Regulations for review of research protocols, the research study listed above has been re-approved for the following period of time:

Your research study has been re-approved from 05/13/2009 - 05/12/2010 . (expires 12am [midnight] of this date.)

RESPONSIBILITIES OF PRINCIPAL INVESTIGATOR FOR ONGOING PROTOCOLS:

- (1) Report **immediately** to the IRB any unanticipated problems.
- (2) Proposed changes in approved research during the period for which IRB approval cannot be initiated without IRB review and approval, except when necessary to eliminate apparent immediate hazards to the participant. Changes in approved research initiated without IRB review and approval initiated to eliminate apparent immediate hazards to the participant must be promptly reported to the IRB, and reviewed under the unanticipated problems policy to determine whether the change was consistent with ensuring the participants continued welfare.
- (3) Report any significant findings that become known in the course of the research that might affect the willingness of subjects to continue to take part.
- (4) Insure that only persons formally approved by the IRB enroll subjects.
- (5) Use **only** a currently approved consent form (remember approval periods are for 12 months or less).
- (6) **Protect the confidentiality of all persons and personally identifiable data, and train your staff and collaborators on policies and procedures for ensuring the privacy and confidentiality of participants and information.**
- (7) Submit for review and approval by the IRB all modifications to the protocol or consent form(s) prior to the implementation of the change.
- (8) Submit a **Continuing Review Report** for continuing review by the IRB. Federal regulations require **IRB review of on-going projects no less than once a year** (a Continuing Review Report form and a reminder letter will be sent to you 2 months before your expiration date). Please note however, that if you do not receive a reminder from this office about your upcoming continuing review, it is the primary responsibility of the PI not to exceed the expiration date in collection of any information. Finally, it is the responsibility of the PI to submit the Continuing Review Report before the expiration period.

(9) Notify the IRB when the study has been completed and complete the Final Report Form.

(10) Please help us help you by including the above protocol number on all future correspondence relating to this protocol.

Thank you for your help in this matter.

Sincerely,

A handwritten signature in black ink, appearing to read "Jody L. Jensen". The signature is fluid and cursive, with the first name "Jody" being the most prominent part.

Jody L. Jensen, Ph.D.
Professor
Chair, Institutional Review Board

Appendix E: GPAQ Cleaning and Scoring Instructions

4 Cleaning GPAQ data

Introduction It is important to standardize the way in which the data collected are cleaned and analysed. Please use the guidelines below when cleaning and analysing your data.
The cleaning and analysis guidelines use the coding column in the questionnaire as an identifier.

Cleaning You should clean all domains as a combined set. While some of the calculations of results use all the domains and others use only one of the domains, it is necessary that each respondent has an overall "clean" response to all physical activity questions. To be included in the analyses, each participant must have a valid response for at least one domain and have no invalid responses for any domains.

Check for the following for all the domains.

If...	Then...
Values in the hours column are 15, 30, 45, or 60	move them into the corresponding minutes variable, if the corresponding minutes variable is empty or zero (most likely a data recording error).
Maximum values: If for at least one "sub-domain" (vigorous work, moderate work, transport, vigorous recreation, or moderate recreation activity) the value of hours+minutes >16 hours	remove the case from all analyses.
If a respondent reports implausible values (eg., >7 days in any days column)	remove the case from all analyses.
If a respondent has inconsistent answers (eg., 0 days, but values >0 in the corresponding time variables)	remove the case from all analyses.
If one whole "sub-domain" (vigorous work, moderate work, transport, vigorous recreation, or moderate recreation activity) has missing values, but the other "sub-domains" are valid	include the case in the analysis, assuming no activity (0 days, 0 time) for this "sub-domain". That means that, as long as at least one "sub-domain" has valid answers, and all others are missing, this person will be included in analyses.

Notes Overall, this cleaning method should result in the same denominator across all domains and all analyses.

For information on how to create P3, P6, P9, P12, and P15 see the Cleaning GPAQ with EpiInfo section at the end of this document (p. 12).

Continued on next page

7 Analysis Guidelines and Calculations

Introduction A population's physical activity (or inactivity) can be described in different ways. The two most common ways are
(1) to estimate a population's mean or median physical activity using a continuous indicator such as MET-minutes per week or time spent in physical activity, and
(2) to classify a certain percentage of a population as 'inactive' by setting up a cut-point for a specific amount of physical activity.
The following guidelines describe both how to derive at continuous as well as categorical indicators when analysing GPAQ data.

Continuous Indicator As described in the overview (p. 2), MET values are applied to the time variables according to the intensity (moderate or vigorous) of the activity. Applying MET values to activity levels allows us to calculate total physical activity.
For the calculation of a person's overall energy expenditure using GPAQ data, the following MET values are used:

Domain	MET value
Work	• Moderate MET value = 4.0 • Vigorous MET value = 8.0
Transport	Cycling and walking MET value = 4.0
Recreation	• Moderate MET value = 4.0 • Vigorous MET value = 8.0

Categorical Indicator For the calculation of a categorical indicator, the total time spent in physical activity during a typical week, the number of days as well as the intensity of the physical activity are taken into account.
The three levels of physical activity suggested for classifying populations are low, moderate, and high. The criteria for these levels are shown below.

- **High**
A person reaching any of the following criteria is classified in this category:
 - Vigorous-intensity activity on at least 3 days achieving a minimum of at least 1,500 MET-minutes/week OR
 - 7 or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of at least 3,000 MET-minutes per week.
- **Moderate**
A person not meeting the criteria for the "high" category, but meeting any of the following criteria is classified in this category:
 - 3 or more days of vigorous-intensity activity of at least 20 minutes per day OR
 - 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day OR
 - 5 or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes per week.
- **Low**
A person not meeting any of the above mentioned criteria falls in this category.

7 Analysis Guidelines and Calculations, Continued

Levels of total physical activity	Description: Percentage of respondents classified into three categories of total physical activity.
	Instrument questions: • P1-P6a&b: activity at work • P7-Pa9&b: travel to and from places • P10-P15a&b: recreational activities

Level of total physical activity							
Age Group (years)	Gender						
	n	% Low	95% CI	% Moderate	95% CI	% High	95% CI

Questions Used	P1-P15a&b								
Program	Ptotallevels (unweighted), PtotallevelsWT (weighted)								
Equations	Total physical activity MET-minutes/week (= the sum of the total MET minutes of activity computed for each setting) Equation: Total Physical Activity = [(P2 * P3 * 8) + (P5 * P6 * 4) + (P8 * P9 * 4) + (P11 * P12 * 8) + (P14 * P15 * 4)] <table border="1"> <tr> <th>Level of total physical activity</th><th>Physical activity cutoff value</th></tr> <tr> <td>High</td><td> • IF: (P2 + P11) ≥ 3 days AND Total physical activity MET minutes per week is ≥ 1500 OR • IF: (P2 + P5 + P8 + P11 + P14) ≥ 7 days AND total physical activity MET minutes per week is ≥ 3000 </td></tr> <tr> <td>Moderate</td><td> • IF: level of physical activity does not reach criteria for high levels of physical activity AND at least one of the following: • IF: (P2 + P11) ≥ 3 days AND ((P2 * P3) + (P11 * P12)) ≥ 3*20 minutes OR • IF: (P5 + P8 + P14) ≥ 5 days AND ((P5 * P6) + (P8 * P9) + (P14 * P15)) ≥ 150 minutes OR • IF: (P2 + P5 + P8 + P11 + P14) ≥ 5 days AND Total physical activity MET minutes per week ≥ 600 </td></tr> <tr> <td>Low</td><td>IF level of physical activity does not reach the criteria for either high or moderate levels of physical activity</td></tr> </table>	Level of total physical activity	Physical activity cutoff value	High	• IF: (P2 + P11) ≥ 3 days AND Total physical activity MET minutes per week is ≥ 1500 OR • IF: (P2 + P5 + P8 + P11 + P14) ≥ 7 days AND total physical activity MET minutes per week is ≥ 3000	Moderate	• IF: level of physical activity does not reach criteria for high levels of physical activity AND at least one of the following: • IF: (P2 + P11) ≥ 3 days AND ((P2 * P3) + (P11 * P12)) ≥ 3*20 minutes OR • IF: (P5 + P8 + P14) ≥ 5 days AND ((P5 * P6) + (P8 * P9) + (P14 * P15)) ≥ 150 minutes OR • IF: (P2 + P5 + P8 + P11 + P14) ≥ 5 days AND Total physical activity MET minutes per week ≥ 600	Low	IF level of physical activity does not reach the criteria for either high or moderate levels of physical activity
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Moderate	• IF: level of physical activity does not reach criteria for high levels of physical activity AND at least one of the following: • IF: (P2 + P11) ≥ 3 days AND ((P2 * P3) + (P11 * P12)) ≥ 3*20 minutes OR • IF: (P5 + P8 + P14) ≥ 5 days AND ((P5 * P6) + (P8 * P9) + (P14 * P15)) ≥ 150 minutes OR • IF: (P2 + P5 + P8 + P11 + P14) ≥ 5 days AND Total physical activity MET minutes per week ≥ 600								
Low	IF level of physical activity does not reach the criteria for either high or moderate levels of physical activity								
Program Information	Places each respondent into one of 3 categories of physical activity. Before any of the below variables are created ALL CleanRecode programs are called. To be included in the output, the respondent must have either left blank or given a valid response to each subset of the physical activity questions AND have given a valid response to <u>at least one subset</u> of the physical activity questions (CLN=1).								

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