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Investigation of Web-Based Motivational Interviewing to Increase Physical Activity Participation Among Adults

Sasha Karnes
University of Wisconsin-Milwaukee

INVESTIGATION OF WEB-BASED MOTIVATIONAL INTERVIEWING TO INCREASE PHYSICAL ACTIVITY PARTICIPATION AMONG ADULTS

by

Sasha L. Karnes, M.S.

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ABSTRACT
INVESTIGATION OF WEB-BASED MOTIVATIONAL INTERVIEWING TO INCREASE PHYSICAL ACTIVITY PARTICIPATION AMONG ADULTS

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Under the Supervision of Professor Barbara B. Meyer

Interventions to enhance physical activity (PA) participation are needed given the high prevalence of under-activity and inactivity (CDC, 2001) and related occurrence of negative health consequences among the general adult population (Kung, Hoyert, Xu, & Murphy, 2008). Preliminary support for a therapeutic technique called Motivational Interviewing (MI) suggests promise for application to enhance PA participation (Burke, Arkowitz, & Menchola, 2003). Given the need for interventions to enhance PA and the preliminary support for MI as an intervention to increase PA, the aims of the current study were to: (a) determine if web-based MI is effective in enhancing PA participation, and (b) assess the mechanisms by which web-based MI enhances PA through changes in targeted cognitive variables. Participants (n= 23, under-active or inactive adults) engaged in four web-based MI sessions. Steps per day, PA, and cognitive variables were assessed across time. Efficacy of MI in enhancing PA participation was demonstrated through: (a) increases in steps per day (t[22]= 2.085, p = 0.049); (b) increases in total PA energy expenditure per week(χ^2= 8.430, p = 0.015); and (c) increases in moderate intensity PA energy expenditure per week (χ^2= 13.853, p = 0.001). Although mediation of change in PA by cognitive variables was inconclusive due to sample size, changes were observed in the expected direction for cognitive variables including: (a) percentage of participants

classified as action or maintenance stages of change (pre = 25.00%, post1= 70.81%, post2 = 68.18%); (b) decisional balance pros ($F[2,42] = 16.192$, $p < 0.001$) and cons ($F[2,42] = 12.755$, $p < 0.001$); (c) behavioral processes of change ($F[2,20] = 7.010$, $p = 0.005$); (d) self-efficacy ($F[2,42] = 3.297$, $p = 0.047$); (e) intrinsic regulation for PA ($F2,38] = 14.274$, $p < 0.001$); and (f) PA enjoyment ($F[2,2] = 3.851$, $p = 0.038$). Implications of the current findings are that web-based MI could be used as a tool to promote PA participation. Additional research is needed to corroborate the current findings, and to refine MI program content by further considering cognitive mediators in a larger sample.

DEDICATION

For my Mother and my children.

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CHAPTER I: INTRODUCTION

Background

The Center for Disease Control (CDC) recently listed insufficient physical activity (PA) as the third highest ranked cause of preventable death among persons in the United States (U.S.), after tobacco and poor diet, (Mokdad, Marks, Stroup, & Gerberding, 2004). In addition, insufficient PA participation is inextricably linked to the occurrence of obesity, which is related to diseases including diabetes mellitus, which is the ranked sixth on the proximate causes of death list (Kung, Hoyert, Xu & Murphy, 2008). Current recommendations for adults set forth by the CDC and the American College of Sports Medicine (ACSM) suggest that to prevent disease and to maintain health, adults (ages 18-65) should partake in either: (a) 30 minutes or more of moderate intensity physical activity (PA) on 5 or more days per week; (b) 20 minutes or more vigorous PA on 3 or more days per week or; (c) a combination of moderate and vigorous intensity activity, such as partaking in moderate activity for 30 minutes or more twice per week and jogging for 20 minutes or more 2 times per week (Haskell et al., 2007).

Based on data gathered between 2001 and 2005, over half of the adult population in the U.S. does not meet the moderate intensity PA recommendation stated above (CDC, 2007). Based on findings of the Behavioral Risk Factor Surveillance System (BRFSS) conducted by the CDC (2001), only 25% of the adult population in the U.S. engages in recommended levels of PA (CDC, 2001a). Additionally, approximately 45% of the remaining population reported engaging in some activity, while not meeting the moderate

activity recommendation, whereas nearly 30% of the population was completely sedentary (CDC, 2001a).

Due to high prevalence of insufficient PA participation among adults in the U.S., increasing PA is a public health priority (DHHS, 2000). The proposed research was designed to guide and inform PA intervention delivery. Specifically, Motivational Interviewing (MI) applied in a web-based format was investigated as an intervention to facilitate PA participation.

Motivational Interviewing is a brief clinical technique gaining popularity as a method for delivering PA interventions that lends to clinical settings, with preliminary support for effectiveness (Britt, Hudson, & Blampied, 2004; Hettema, Steele, & Miller, 2005; Huang, 2005; Scales & Miller, 2003; Shinitzky & Kub, 2001). Notably, MI was also recently adapted as a web-based PA intervention with preliminary success (Chiauzzi, Brevard, Thum, Decembrele, & Lord, 2008; Webber, Tate, & Quintiliani, 2008). However, it is not certain whether web-based MI can enhance PA participation in a web-based format. Furthermore, regardless of delivery modality (i.e. face-to-face, print, web), the underlying mechanisms by which MI is effective are not clear. That is, MI maps onto cognitive behavioral theories which are successfully applied to enhance PA, but the cognitive mediators affected by MI, which mediate PA change, have not been investigated. The current research was conducted to determine whether web-based MI is effective to increase PA participation, and to investigate cognitive mediators of behavior change.

Statement of Purpose

Aims

The broad objective of the proposed study is to cultivate empirical guidance for PA intervention delivery. To inform PA interventions, a progressive approach to delivering MI in a web-based format that is brief and accessible was investigated. Findings will inform clinical applications for PA enhancement by assessing effectiveness of web-based MI and guiding content of MI. The Aims of the current study were:

1. To determine if web-based MI is effective in enhancing PA participation.
2. To assess the mechanisms by which web-based MI enhances PA through changes in targeted cognitive variables.

Research Questions

Research questions pertaining to cognitive mediators of the relationship between web-based MI and PA, were investigated. The proposed model (See Figure 1) outlines cognitive variables of interest in a format consistent with the MI ideology (Miller & Rollnick, 2002) for facilitating willingness, perceived ability, and readiness to change one's behavior. The model posits that willingness, perceived ability, and readiness to engage in PA will be affected by web-based MI, and will thereby affect PA participation. Willing, ready, and able variables are operationalized categories that include theoretically derived cognitive variables. Specifically, the *willing* category is defined by *intentions, decisional balance*, and *intrinsic motivation/enjoyment* related to PA. The *ready* category is defined by *readiness to change* and *processes of change*. Finally, the *able* category includes self-efficacy and *perceived barriers* related to PA. As is depicted in

the model, these variables are influenced by web-based MI, and influence each other in a synergistic fashion to predict PA participation.

The specific hypotheses of the study include that:

Hypothesis 1: Web-based MI will lead to increased PA;

Hypothesis 2: Web-based MI will lead to stage progression in the direction of increased readiness to participate in PA;

Hypothesis 3: Web-based MI will have a direct effect on targeted cognitive variables;

Hypothesis 4: Changes in targeted cognitive variables will have an indirect effect on PA participation.

Limitations

Results of the proposed study do not generalize to populations excluded from participation such as: (a) persons without internet access, (b) persons who are sufficiently physically active, (c) pregnant women and persons who are not recommended to start a PA program, or (d) persons not between the ages of 21 and 65 years of age. The reasons for excluding these respective populations are that (a) the intervention is designed for application among persons with internet access, (b) the intervention is designed to target persons who engage in insufficient PA, (c) pregnant women or persons not recommended for PA by their physician's should seek physician advice regarding PA rather than following general adult recommendations which are suggested by the proposed intervention, and (d) persons under 21 or over 65 years of age may require alternative PA guidelines than guidelines for the adult general population.

Delimitations

The proposed intervention did not include components of personalized feedback or one-on-one interactions. The intervention is designed to be easily distributed and accessed by patients who are referred through primary care without the need for investment of time by health professionals. Although personalized feedback was not included, participants were encouraged to reflect on the feedback that physicians already gave them, as well as their own progress to goals pertaining to their PA participation. Also, although one-on-one interaction was not included as part of the proposed intervention, participants were encouraged to interact by reflecting on PA thoughts and behaviors.

Significance

Scientific Significance

Web-based MI offers a practical strategy for increasing PA, and the current study contributes to the existing body of scientific literature surrounding intervention application. Specifically, the study adds to the limited body of literature describing investigation of web-based MI as a method to enhance PA participation. Findings are pertinent to the advancement of both MI and PA fields of inquiry.

Significance pertaining to Motivational Interviewing literature. In the MI field of inquiry, current research is needed to: (a) strengthen findings that MI is effective to enhance PA; (b) clarify whether web-based MI can enhance PA; and (c) understand the mechanisms by which MI is effective. The current research adds to the limited body of research which investigates MI for PA. In addition, whereas most research has focused on MI that is face-to-face or telephone-based, the current research addresses whether

web-based MI is also effective. Finally, a major contribution of the current research is that information was gained regarding the theoretical mechanisms by which MI is suggested to be effective.

Significance pertaining to physical activity literature. The purpose of the MI intervention developed was to enhance PA participation. Areas warranting further inquiry within the existing body of PA literature were addressed in order to (a) evaluate a web-based intervention for enhancing PA participation; (b) enhancing understanding of theoretically based components of a web-based intervention. The application of research methods that allowed for strength in conclusions including application of an objective measure to assess PA participation contributed to the growing body of intervention efficacy research. In addition, the study advanced our understanding of cognitive mechanisms that may mediate PA participation.

Practical Significance

Given that increasing PA is a public health initiative, the outcomes of the study further inform intervention delivery efforts. Delivery options that are accessible, low in cost, and require few clinical hours are optimal. The current study offers a practical approach to delivery given the use of a web-based delivery modality, as well as implementation of MI as a brief intervention. That is, web-delivery is low cost and widely accessible. Motivational Interviewing is brief, and when implemented in a web-format, greatly reduces the need for clinical hours to address PA issues. There is an emergent need for interventions that lend to practical applications such as in physician settings, and the current study is geared at informing such endeavors.

The participants were recruited through primary care to participate in a web-intervention, and this recruitment scheme lends readily to direct application, given support for intervention efficacy. Findings of the proposed study further inform clinical applications for PA enhancement, by guiding the content of MI.

CHAPTER II: Literature Review

Overview

Despite ongoing efforts to increase physical activity (PA) participation, the general public overwhelmingly is insufficiently physically active (CDC, 2001a). Efforts to increase PA among adults to date have been only partially successful, and additional research is needed to elucidate effective and efficient strategies (Marcus et al., 2006). The effectiveness of various intervention types in terms of theoretical components (i.e., cognitive-behavioral, social cognitive) as well as delivery modality (i.e., face-to-face, telephone, print, web-based) are still being considered through ongoing research. Building on what is understood about intervention types and delivery, current research efforts focus on developing approaches to PA promotion that lend to practical applications. Emergent findings include that web-based interventions which are theoretically-based may be both practical and effective to enhance PA participation (Carr et al., 2008; Napolitano et al., 3003; Sciamanna et al., 2002).

Within the context of a web-based intervention, one counseling style called Motivational Interviewing (MI) is consistent with cognitive-behavioral and social-cognitive theories, and has recently been supported for application using a variety of delivery modalities to increase PA participation (Britt et al., 2004; Hettema et al., 2005; Huang, 2005; Scales & Miller, 2003; Shinitzky & Kub, 2001). With recent research focusing on web-based delivery (Chiauzzi, et al., 2008; Webber et al., 2008). Despite support for application, the underlying theoretical mechanisms by which MI can influence PA have not yet been investigated. While, MI is delivered in order to influence cognitions including self-determination, self-efficacy, readiness to engage in PA, and

cognitive dissonance, there is no evidence to support that MI can influence these cognitions as mediators of PA behavior change. Additional research is needed to investigate underlying cognitive factors that are affected by web-based MI (Chiauzzi et al, 2008; Webber et al, 2008), and whether those factors in turn influence PA participation.

The current literature review describes the need for more research to investigate the potential for applying web-based MI to enhance PA participation. First, an overview of the prevalence and consequences of insufficient PA participation is provided. Then, an introduction to theoretical orientation, and delivery modalities pertaining to the current research is provided, followed by a review of the current directions in intervention research including a description of MI and the theories that map onto the counseling style. Finally, rationale for utilizing web-delivery and more specifically, rationale for applying web-delivery that is guided by MI to enhance PA, is given.

Definition of the Problem: Insufficient Physical Activity Participation

Most of the adult population in the United States fails to meet recommendations for PA participation, and among those not meeting recommendations, many are considered to be sedentary (CDC, 2001a). Epidemiological investigations to date suggest that intensity and duration of PA participation is directly associated with a number of health variables, where more PA is consistently associated with better health (CDC, 2001b). While PA is health-enhancing, leading a lifestyle that does not include sufficient PA participation is health-harming. That is, insufficient PA participation is associated with a variety of disease-states, many of which are inter-related.

Physical Activity for Disease Prevention

To highlight the importance of increasing PA participation, consider that PA is protective against heart disease, diabetes, and cancer. Conditions related to cardiovascular function including coronary heart disease (CHD), acute myocardial infarction, and other adverse coronary events are inversely associated with PA. Specifically, there is a dose-response relationship between PA participation and CHD (Lee, Sesso, & Paffenbarger, 2000), occurrence of acute myocardial infarction (Lakka et al., 1994), and other adverse cardiovascular events (Manson et al., 2002). Mechanisms by which PA influences cardiovascular health include protection against hypertension (Blair, Goodyear, Gibbons, & Cooper, 1984; Chobanian et al., 2003; Seals, Silverman, Reiling, & Davy, 1997) and reduction of coronary artery disease through cholesterol regulation (Duncan, Gordon, & Scott, 1991; Kokkinos et al., 1995).

Physical activity may also influence cardiac health by preventing metabolic conditions including overweight/obesity and Type II diabetes. According to the Centers for Disease Control (CDC), persons who are either overweight given a body max index (BMI) of 25 to 29, or obese given a BMI of 30 and higher are at greater risk of cardiovascular disease and Type II diabetes. Through increased caloric expenditure, PA participation is associated with a decreased BMI (Jakicic, Marcus, Gallagher, Napolitano, & Lang, 2003; Lavery & Loewy, 1993; Williamson et al., 1993) and therefore reduced risk of cardiovascular disease and Type II diabetes (Kriska et al., 2003; Manson et al., 1991).

In addition to reduced risk for cardiovascular and metabolic disorder, although mechanisms are not known, PA participation is also implicated in cancer prevention.

Review of epidemiological research suggests that PA participation is associated with decreased risk for breast and colon cancer (Friedenreich & Orenstein, 2002). Also, there is some evidence to support that prostate, lung and endometrial cancer may also be prevented through PA participation (Friedenreich & Orenstein, 2002).

Summary of Indications

Participation in PA is indicated for the prevention of life-threatening health conditions (i.e. cardiovascular disease, Type II diabetes, specific cancers). The consensus of epidemiological investigation is that PA participation is most often inversely associated with negative health outcomes in a dose response fashion (Lakka et al., 1994; Lee et al., 2000; and Manson et al., 2002). Further, PA participation at a level consistent with public health guidelines is sufficient to observe health benefits, where in many cases there is evidence that participation at any level is associated with some health benefit compared to inactivity. Despite this knowledge, a large portion of the population remains inactive or insufficiently active relative to PA guidelines. Therefore, the focus of the current research was on the development and evaluation of strategies to increase PA participation.

Overview of Interventions for Physical Activity Promotion

Interventions that have been applied to promote PA vary in terms of theoretical orientation as well as delivery modality. Most PA interventions are based primarily in cognitive-behavioral and social cognitive theories. Theoretically-based interventions can be delivered in face-to-face (individual or group), telephone, print, and internet formats.

Theoretical Orientation

The emergent recommendation is that interventions designed to increase PA participation should be theoretically-based (Rovniak, Hovell, Wojcik, Winett, & Martinez-Donate, 2005). Theories informed by a cognitive-behavioral and social cognitive orientations are supported for application to enhance PA participation (Marcus et al., 2006). Interventions that are based in cognitive-behavioral theory (CBT) are designed to alter cognitions in effort to modify related behaviors. Social cognitive theory (SCT) includes a direct focus of a person's environment as predicting behavior in addition to cognitions (Bandura, 1986). In SCT, individuals have the capability of self-reflection and self-regulation within the suggested interacting, multi-factorial context (Bandura, 1986). Theories that are frequently cited within the CBT-and SCT-based intervention literature include self-determination theory (Deci & Ryan, 1985), self-efficacy theory (Bandura, 1977), and the transtheoretical model of behavior change (Prochaska, DiClemente, & Norcross, 1992).

These theories are typically combined to inform intervention delivery (Marcus et al., 2006) and also map onto MI (Miller & Rollnick, 2002). Although cognitive dissonance theory (Festinger, 1957) is not historically applied to PA, this theory is a part of the framework for MI as well (Miller & Rollnick, 2002), and investigation of the relationship between PA interventions and theoretical constructs is needed (Marcus et al., 2006). The current study includes theoretically relevant variables as mediators of the impact of MI on PA. After addressing delivery modalities, MI will be defined and each of the theories mentioned above will be discussed in detail.

Delivery Modality

Cognitive-behavioral and social cognitive interventions can be delivered though either face-to-face options (individual or group) or non face-to-face options termed *mediated* approaches (Wantland, Portillo, Holzemer, Slaughter, & McGhee, 2004). Mediated approaches include mass media, print, telephone and internet delivery (Wantland et al., 2004). Web-based interventions are a priority for ongoing research efforts for several reasons including the recent proliferation of use of the internet (Jones & Fox, 2009), efficiency of delivery (Marcus, Nigg, Riebe & Forsyth, 2000; Woolf et al., 2006), and preliminary support for application (Carr et al., 2008; Chiauzzi et al., 2008; Marcus, Lewis, Williams, Dunsiger et al., 2007; Napolitano et al., 2003; Rovniak et al., 2005; Webber et al., Williams, Herman-Stahl, Calvin, Pemberton, & Bradshaw, 2009). A recent report suggests that adult internet use is increasing, particularly among adults ages 18-55 (Jones & Fox, 2009). In 2008, 78% of adults in the 50-54 age group were online, and even higher proportions of younger adults were online (Jones & Fox, 2009). These findings suggest that the internet is accessible to adults of all ages.

Secondary to increasing accessibility among adults, web delivery is suggested as a practical and cost-effective alternative to face-to-face methods for intervention delivery which are often used in clinical settings (Marcus et al., 2000). The development of interactive *expert systems* can require substantial overhead cost of as much as $125,000 in the year 2006 (Woolf et al., 2006). Still, the relative value of web-delivered interventions in terms of cost-effectiveness may outweigh the financial cost upfront given stated lack of physician and medical personnel resources to deliver much needed PA

interventions during clinical time. Furthermore, it is possible that less costly more simplistic web applications can be used, a possibility which has not yet been tested.

Perhaps of greater importance than considering cost, there is a body of literature that suggests that web-based PA interventions can in fact be effective to enhance PA participation (Carr et al., 2008; Chiauzzi et al., 2008; Marcus, Lewis, Williams, Dunsiger et al., 2007; Napolitano et al., 2003; Webber et al., 2008; Williams et al., 2009). Web-based PA interventions vary greatly in terms of scope and content. Standard web pages are used as interventions by allowing individuals to explore and seek information (Lewis et al., 2008). Chat rooms are used as intervention by operating as support groups (Woodruff, Conway, Edwards, Elliott, & Crittenden, 2007). Theoretically-based interventions are self-guided and interactive, oftentimes including feedback and self-monitoring capabilities (Van den Berg, Schoones, & Vliet Vlieland, 2007). Notably, web-based PA interventions often involve a combination of these approaches.

Although there is not consensus about which approach to web-based applications is best, there is preliminary support for web-based PA interventions as a whole (Carr et al., 2008; Chiauzzi et al., 2008; Marcus, Lewis, Williams, Dunsiger et al., 2007; Napolitano et al., 2003; Webber et al., 2008; Williams et al., 2009). Additional research is needed to refine techniques and maximize efficacy. It is suggested that theoretically-based applications which are interactive should be explored further as a method of enhancing PA participation (Marcus et al., 2006).

Current Directions in Physical Activity Intervention Research: Web-based Motivational Interviewing

One clinical technique, which maps onto empirically supported components of CBT and SCT, and has been adapted for web-delivery, is MI (Chiauzzi et al., 2008; Webber et al., 2008; Williams et al., 2009; Woodruff et al., 2007). The MI approach to behavior change is a brief and effective way to enhance PA participation (Ang, Kesavalu, Lydon, Lane, & Bigatti, 2007; Bennett, Lyons, Winters-Stone, Nail, & Scherer, 2007; Miller & Rollnick, 2002; Scales & Miller, 2003). Prior to discussing research supporting the implementation of MI, and more specifically web-based MI, a definition and description of the counseling style is provided.

Introduction to Motivational Interviewing

Motivational Interviewing is, "A client centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence (Miller & Rollnick, 2002, p. 25)." Miller and Rollnick (2002) indicate that MI can be applied to facilitate readiness to change, and ultimately, behavior change. This approach was originally developed for applications in the substance abuse domain, and recent reviews suggest that the counseling style has been applied as an intervention to facilitate change or to enhance compliance in a variety of health behaviors (e.g., smoking cessation, condom usage, weight control, disordered eating) (Britt et al., 2004; Hettema et al., 2005; Miller & Rollnick, 2002; Shinitzky & Kub, 2001). Motivational Interviewing has recently been extended for application to the PA domain to enhance PA participation.

Although preliminary support exists for implementation of MI to enhance PA (Ang et al., 2007; Bennett et al., 2007; Carels et al.; 2007; Harland et al., 1999; Kremen et al., 2006), guidelines for application in a clinical setting have not been identified nor have theoretical mechanisms which would inform guidelines as they pertain to PA. Similarly, recently adapted web-applications of MI to promote health behavior change (Chiauzzi et al., 2008; Webber et al, 2008; Williams et al., 2009; Woodruff et al., 2007) have yet to be tested to determine efficacy.

Theoretical Overlay of Motivational Interviewing

As part of evaluating the efficacy of MI delivery, assessment of theoretically-based mechanisms of effect is needed. Several social cognitive theories provide a framework for selecting cognitive variables that may serve as mediators of the effect of MI on PA participation. Theories identified as mapping onto MI include self-determination theory (SDT) (Deci & Ryan, 1985), self-efficacy theory (SE) (Bandura, 1977), the transtheoretical model (TTM) (Prochaska et al., 1992), and cognitive dissonance theory (Festinger, 1957). A description of each theory, and how that theory pertains to MI delivery, is included in the preceding sections.

Although developers Miller and Rollnick (2002) do not specifically map out theoretical mechanisms, they define MI as a counseling style which differs from other traditional styles in that the practitioner facilitates autonomously driven change in a directive manner by applying four basic principles. The first principle is to *express empathy*, which is inspired by Carl Rogers' early psychotherapeutic client-centered counseling approach (Miller & Rollnick, 2002). It is thought that empathy and acceptance will encourage openness of communication, and allow an environment that

supports change. The second principle is to *develop a discrepancy* by amplifying an individual's conflict between his values or goals and current behaviors. In essence, creating the discrepancy involves highlighting the cognitive dissonance that a person experiences to facilitate him to change. The third principle is to *roll with resistance* as a process of acknowledging and accepting an individual's resistance, or possibly reframing resistance in such a way that an individual will be guided to think about or discuss change. The final principle is to *support self-efficacy* by building the person's self-perception of ability to change in order to enhance treatment outcomes (Miller & Rollnick, 2002). Motivational Interviewing involves applying these four principles using a unique counseling approach, described below.

Approach to Delivery of Motivational Interviewing

Investigating the MI approach for PA applications is appealing not only because of the theoretical overlay, which includes social cognitive theories that are widely accepted for PA applications, but also because of the unique aspects of MI that deviate from traditional counseling approaches. The basic approach of MI involves collaboration, evocation, and autonomy support, which are in direct conflict to counseling approaches involving confrontation, education, and authority, respectively (Miller & Rollnick, 2002). According to Miller & Rollnick (2002), collaboration involves accepting the client perspectives and facilitating a climate that is "conducive but not coercive to change" (p. 35). Confrontation is the opposite, where the client's perspectives are not valued and respected. Evocation involves enhancing intrinsic motivation to change by "drawing on the client's own perceptions, goals, and values" (Miller & Rollnick, 2002, p. 35). This is the opposite of educational approaches which

do not acknowledge that change is internally driven, but rather that information will facilitate change. Finally, autonomy is supported by acknowledging the propensity for *self-directed* change. In the opposite authoritarian approach, change would be imposed upon the client under the direction or authority of the practitioner (Miller & Rollnick, 2002).

Another unique feature of MI is the acknowledgement that people often experience ambivalence regarding change. In other words, a person may want to change and at the same time he is able to state reasons for which he does not want to change. In MI, an attempt is made to address and work through this ambivalence, which facilitates progression toward readiness to change. During MI, *change talk* is encouraged as a strategy to work through ambivalence related to behavior change. Change talk occurs when a person acknowledges the discrepancy, resistance to change is lessened, and/or the person expresses statements for change. Change talk is characterized by statements of desire, ability, reasons, need, and/or commitment related to behavior change (Amrhein, Miller, Yahne, Palmer, & Fulcher, 2003; Miller & Rollnick, 2002). Change talk is an important occurrence during MI given findings that it mediates the MI delivery and client behavior change, where stronger change talk predicts behavior change (Amrhein, 2004; Amrhein et al., 2003; Moyers et al., 2007).

In addition to change talk, Miller and Rollnick (2002) use the acronym *OARS* to identify specific strategies for eliciting individual behavior change. The *O* in *OARS*, encourages the asking of open-ended questions. The *A* stands for the affirmation of individuals. The *R* stands for reflective listening, which is conducted throughout an MI session. And the *S* acknowledges the need to summarize the discussion in a way that

supports movement toward readiness to change. Miller and Rollnick (2002) describe specific applications toward change through utilization of the methods suggested in *OARS*, which they characterize as tools in a toolbox that can be used during sessions.

Motivational Interviewing Summary

Informed intuitively by previously identified social cognitive theories, MI is applied to enhance internal readiness to change behavior. Motivational Interviewing is unique compared with interventions which are based exclusively on one or more social cognitive theories in that it is a directive client-centered approach (Miller & Rollnick, 2002). The method of MI is directive, in that the client is guided to move toward behavior change that is volitional rather than that which is delivered through more authoritarian strategies (e.g., direct persuasion). The goal of MI is to work through ambivalence in order to facilitate behavior change. Motivational Interviewing is unique in that it offers an alternative to traditional advice giving, confrontational, and/or educational approaches which may be less effective. Given that MI is a relatively new counseling method, there is a growing body of evidence to support implementation across a variety of health behaviors (Miller & Rollnick, 2002).

Clinicians suggest that MI can be efficiently and effectively incorporated into settings such as primary care to encourage PA participation (Britt et al., 2004; Hettema et al., 2005; Huang, 2005; Scales & Miller, 2003; Shinitzky & Kub, 2001). Adapting MI to a web-based delivery format is likely to enhance accessibility and to decrease the burden of health care staff for delivery, thereby enhancing efficiency of intervention delivery.

Despite preliminary support for applying MI to enhance PA, there is a lack of theory-based research to identify the mechanisms of MI and to guide delivery toward this end (Ang et al., 2007; Bennett et al., 2007; Carels et al., 2007; Harland et al., 1999; Kreman et al., 2006; Smith et al., 1996).

Theoretical Basis for Cognitive Mediators of Motivational Interviewing and Physical Activity

The MI approach is premised on the notion that in order for behavior change to occur, a person must be willing, able, and ready to change (Miller & Rollnick, 2002). That is, a person must: (a) believe change is important/want to change (i.e., willing); (b) believe that change is possible (i.e., able); and (c) express that change is a priority at the present time (i.e., ready). The theoretical constructs which map onto ready, willing and able categories are described in detail in preceding sections.

Specifically, findings and limitations of investigations related to SDT which captures the willingness component, SE theory which captures perceived ability, and the TTM of behavior change which captures readiness to change are discussed, as is cognitive dissonance theory. Of note, many of the theoretically-based interventions reviewed in the preceding sections are not termed MI, but include components consistent with the proposed theoretical underpinnings of the MI method. Also, many of the interventions described are not informed by just one theory, rather, informed by a combination of theoretical approaches.

Self-Determination Theory

The main supposition of SDT is that a given behavior is likely to occur more frequently when that behavior is *self-determined* (Deci & Ryan, 1985). Self-determined

behavior is operationally defined as a behavior that occurs autonomously and/or is motivated by internal rather than external factors (Deci & Ryan, 1985; Ryan & Deci, 2000a). Motivation for behavior is classified as either *intrinsic* or *extrinsic* (Deci & Ryan, 1985; Ryan & Deci, 2000a). Intrinsic motivation for behavior is conceptualized as motivation driven by inherent enjoyment associated with a given behavior, whereas extrinsic motivation for behavior is conceptualized as motivation driven by external factors such as an outcome or a reward. According to SDT, behaviors that are intrinsically motivated are more self-determined and more likely to be maintained than behaviors that are extrinsically motivated, which are driven by factors that are relatively more external to the individual (Ryan & Deci, 2000a).

Since not all behaviors are purely internally or externally motivated, a classification system suggested as part of SDT is expanded to a continuum with various degrees of internal and external motivation, including amotivation (Deci & Ryan, 1985; Ryan & Deci, 2000b). Within the continuum, intrinsic motivation is associated with internal regulation that is motivated by factors such as interest, enjoyment, and inherent satisfaction. Conversely, extrinsic motivation is divided into four degrees of regulation ranging from motivation that is purely external to motivation that more closely approximates internal motivation. These four degrees of extrinsic regulation include: (a) integrated regulation, which is associated with internal regulatory factors such as congruence, awareness, and/or synthesis within the self; (b) identified regulation, which is associated with primarily intrinsic motivators, and to a lesser extent extrinsic motivators; (c) introjected regulation, which is associated with primarily external factors, and to a lesser extent internal regulatory factors; and (d) external regulation, which is

associated with external factors such compliance, external rewards and/or punishment. Within the continuum of motivation and associated regulatory styles, intrinsic motivation is at the opposite end of amotivation. The continuum specifies that amotivation involves lack of either intrinsic or extrinsic motivation for behavior. Given amotivation, an individual does not perceive the behavior to be of value and lacks motivation to engage in that behavior altogether (Deci & Ryan, 1985; Ryan & Deci, 2000b).

Self-determination theory for behavior change. Motivational orientations defined within the SDT motivational continuum have implications for behavior prediction. Specifically, behaviors that are primarily intrinsically motivated, including behaviors that are regulated by integrated or identified regulation, are predicted to occur with greater frequency and are more likely to be maintained than behaviors that are relatively more extrinsically motivated. Moving along on the continuum toward amotivation, during introjected regulation, behaviors are primarily externally motivated but do have some internal motivation. Given that there is some internal motivation, these behaviors are expected to occur with less frequency than behaviors associated with integrated regulation that are relatively internally driven. Moving even further along the continuum, externally motivated behaviors are expected to occur infrequently relative to internally or partially internally regulated behaviors, and more often than amotivated behaviors. Finally, behaviors that are amotivated are expected to occur very infrequently, secondary to a lack of perceived value for engaging in a given activity (Ryan & Deci, 2000a).

Identification of factors that contribute to internalized motivation is pertinent given implications for behavior prediction and related modification. By definition,

behaviors that are internally motivated are inherently enjoyable. Therefore, enjoyment is one factor that can be influenced to encourage intrinsic motivation. According to SDT, additional factors that influence internalized motivation for behavior include autonomy, competence, and relatedness (Ryan & Deci, 2000a). Autonomy is suggested as a critical component necessary for internalization of behavior regulation, where behaviors that are autonomously driven are more internalized (Ryan & Deci, 2000a). According to SDT, a person is likely to internalize motivation for behaviors for which she perceives herself to be competent. Relatedness is another factor that is said to influence motivational regulation, where individuals are said to have a basic need of feeling attached/connected to others, and support for fulfilling this need facilitates internalization of motivation for a given behavior (Ryan & Deci, 2000a). In sum, facilitating and supporting enjoyment, autonomy, competence, and relatedness is associated with increased likelihood of internalization of motivational regulation, thereby allowing behavior modification (Ryan & Deci, 2000a).

Self-determination theory and Motivational Interviewing. To reiterate, within SDT, behavior that is intrinsically motivated is more likely to be adopted and/or to be maintained. Specific strategies discussed below are suggested to facilitate intrinsic motivation (Deci, Eghrari, Patrick, & Leone, 1994). One method that allows application of the principle components of SDT to facilitate behavior change is MI (Miller & Rollnick, 2002; Vansteenkiste & Sheldon, 2006). The fundamental basis of MI, which includes autonomy support, collaboration, and elicitation rather than change instillation, maps onto factors identified as contributing to self-determined behavior. For example, by supporting autonomy, collaborating, and eliciting change, a person's motivation is more

likely to be intrinsically than extrinsically motivated. Motivational Interviewing can also be applied to enhance intrinsic motivation by encouraging an individual to engage in behaviors which are enjoyable. The purpose of enhancing intrinsic motivation through application of MI is to increase the likelihood of engagement in desirable behaviors.

For health-enhancing behaviors such as PA participation, MI is often focused on facilitating internally driven behavioral initiation or increasing frequency of behavior (Miller & Rollnick, 2002). To satisfy the goals of MI, consistent with SDT principles, autonomy support is offered by allowing an individual to direct his or her own behavior change rather than being directed by an outside person or agent. Similarly, a collaborative tone is set by the interventionist to create an environment in which a person is likely to perceive lack of external authority and presence of support. In addition, MI is associated with elicitation rather than instillation of change, again whereby an individual directs one's own behavior change rather than imposing any extrinsic encouragement for change (Miller & Rollnick, 2002). Finally, MI includes discussion of a menu of options for behavior change and encourages selection of activities which are enjoyable for a given individual (Rosengren, 2009). In summary, consistent with the principles of SDT, during MI, autonomy, competence, and relatedness are supported. In addition, selection of enjoyable activities is encouraged. Support for these factors contributes to internalized behavioral regulation.

Researchers have identified two processes by which internalization of motivation for behavior occurs. The first process, introjection, involves being aware of the value of the behavior but not accepting it as one's own. For example, an individual who has introjected regulation of PA might acknowledge that PA participation could make him

more fit and attractive to others. In this scenario, the individual values PA for the external approval that could come as a secondary benefit. This person might be sufficiently motivated to engage in PA due to this extrinsic motivation, where long term adherence is not likely given lack of internal motivation. The second process, integration, involves valuing the behavior as one's own with a sense of self-determination (Deci et al., 1994). An individual who has integrated motivation for PA would engage in PA for reasons including inherent enjoyment of the activity. Given integrated motivation, the individual would be more likely to continue PA participation than an individual for whom PA is driven by external factors.

As previously mentioned, in situations where increased occurrence of behavior is a goal, facilitation of self-determination/integration is desirable. Integration occurs given: (a) provision of meaningful rationale for the behavior, (b) acknowledgement of the feelings of the individual, and (c) conveyance of the choice of the individual to participate in a given behavior (Deci et al., 1994). Motivational Interviewing satisfies the three conditions specified as necessary for integration to occur. That is, during MI, integration is facilitated by encouraging self-reflection and providing support through education, by accepting and acknowledging the individual's beliefs and behaviors, and by giving the individual a choice of participating in a given behavior (Deci et al., 1994; Miller & Rollnick, 2002).

The goal of the current study is to assess whether intrinsic motivation for PA, and in turn PA can be enhanced through application of MI. Research to date has focused on SDT applications which are not explicitly MI-based, but which show support that interventions which enhance intrinsic motivation can enhance PA behavior. In the

following section, research which has included principles of SDT for PA enhancement is reviewed.

Self-determination theory for physical activity promotion. Research suggests that SDT principles are applicable to promote internalized motivation, and to predict or promote behaviors such as PA (Bagoien & Halvari, 2005; Deci et al., 1994; Dishman et al., 2005; Hagger, Chatzisarantis, & Biddle, 2002). Although MI encompasses principles of SDT (Miller & Rollnick, 2002; Vansteenkiste & Sheldon, 2006), current research considers SDT-related factors independently of MI-based interventions. Additional research is needed to assess whether MI can influence cognitive factors identified in SDT, and to determine whether manipulation of these factors can enhance PA participation. Cross-sectional and intervention-based research exploring principles of SDT in the PA domain is reviewed below.

Support for self-determination relating to physical activity. Cross-sectional findings, although focusing on adolescents and youth rather than adults, suggest that consistent with the suppositions of SDT, autonomy (Bagoien & Halvari, 2005; Hagger et al., 2002), enjoyment, and competence (Bagoien & Halvari, 2005) are related to PA engagement. Hagger et al. (2005) Studied whether higher autonomy was related to higher intention to engage in PA among adolescents (n = 1099) ranging in age from 12 to 14 years (m age not reported). Self-reported perceived autonomy, measured by a Perceived Locus of Causality inventory with a subscale for intrinsic motivation (Ryan & Connell, 1989) and perceived behavioral control related to PA participation, measured by a 2-item Perceived Behavioral Control inventory, were assessed as predictors of intentions to engage in PA, which were measured using a 3-item Theory of Planned

Behavior questionnaire (Ajzen & Fishbein, 1980). Haggar et al. (2005) found that in a mediated model, intrinsic motivation was a significant predictor of perceived behavioral control ($\beta = 0.71$, $p < 0.01$) and that perceived behavioral control was a significant predictor of intention to engage in PA ($\beta = 0.45$, $p < 0.01$). The authors suggest that autonomous motivation influences perceived behavioral control, which thereby increases intentions to engage in PA.

Building on the finding that autonomous motivation is related to *intention* to participate in PA, research conducted by Bagoien and Halvari (2005) suggests that autonomous motivation among youth ($n = 231$) ranging in age from 12 to 17 years ($M = 16.6$) is related to PA participation. Self-reported autonomous motivation, measured by the Self-Regulation questionnaire (Ryan & Connell, 1989) and competence, measured by the Perceived Competence Scale for Children (Harter, 1981) were assessed as factors relating to PA participation which was quantified by a single item asking about PA participation. Findings indicated that autonomous motivation ($r = 0.58$, $p < 0.001$) and competence ($r = 0.38$, $p < 0.001$) were significantly associated with PA participation. Given this relationship, further consideration of whether these variables can be manipulated to enhance PA participation is warranted.

Support for self-determination theory applications to increase physical activity. Building on the cross-sectional findings that SDT factors including autonomy and perceived competence are related to PA participation, experimental findings suggest that SDT-based interventions are useful to enhance PA participation (Dishman et al., 2005). Although research pertaining to adults is ongoing and results are forthcoming (Jolly et al., 2009; Silva et al., 2008), research involving adolescents supports SDT-based intervention

applications (Dishman et al., 2005). Dishman et al. (2005) investigated the influence of enjoyment on PA participation among high school freshman girls (*M* age = 13.56 years, age range not reported). Girls attending schools in the experimental group (*n* = 1049) participated in the Lifestyle Education for Physical Activity Program (LEAP) and were compared to girls attending schools in the control group (*n* = 1038) who took part in standard PA programs. The LEAP program included various cognitive behavioral strategies for enhancing both enjoyment and SE related to PA (e.g., allowing choice of activities). Surveys assessing enjoyment using the Physical Activity Enjoyment Scale (PACES) (Kendzierski & DeCarlo, 1991), SE using an 8-item scale (Motl, Dishman, Dowda, & Pate, 2004) and PA using the 3-day PA recall (PAR) for young women (Pate, Ross, Dowda, Trost, & Sirad, 2003) were administered at baseline when starting the program in ninth grade and again in spring of that academic year.

Results generated through latent variable structural equation modeling including both groups indicated that the intervention had a significant effect on PA participation ($\beta = 0.10$, $p < 0.05$), and that the effect of the intervention was mediated by factors related to enjoyment. The intervention was also positively associated with increases in factors associated with enjoyment of PA ($\beta = 0.11$, $p < 0.05$), which influenced PA enjoyment ($\beta = 0.45$, $p < 0.05$) as well as SE related to PA ($\beta = 0.33$, $p < 0.05$). Self efficacy predicted PA participation ($\beta = 0.14$, $p < 0.05$), therefore supporting a mediated effect of the intervention on PA participation. These findings suggest that consistent with principles of SDT, activity choice was associated with increased enjoyment. Further, increased enjoyment in addition to enhanced SE contribute to increased participation in PA. In sum, the hypothesis that intervention

effects are mediated by factors including enjoyment and SE are supported by the Dishman et al. (2005) study.

Overall, LEAP program objectives are consistent with those used during MI, such as offering choice to promote enjoyment and supporting autonomy. Although Dishman et al. (2005) used a strong intervention design, results can only be generalized to adolescent girls in a school setting. Results of ongoing research involving adults are forthcoming, and will test whether SDT-based interventions are effective to enhance activity adoption among adults (Jolly et al., 2009; Silva et al., 2008). Both the Jolly et al. (2009) and Silva et al. (2008) studies assessed PA participation as an outcome as well as SDT-identified cognitive variables. Similar to the LEAP program objectives which were consistent with MI principles (i.e., offering choice of activity to promote enjoyment and support autonomy), the Silva et al. (2008) SDT intervention in particular is applied by following MI-guidelines.

Summary of limitations and implications of self-determination theory research.

Findings of research involving factors identified in SDT support that autonomy is related to intentions to participate in PA (Bagoien & Halvari, 2005), and to PA participation (Bagoien & Halvari, 2005; Hagger et al., 2002). Competence (Bagoien & Halvari, 2005) and enjoyment (Dishman et al., 2005) are also related to PA participation. Facilitation of self-determined motivation may be possible through manipulation of specific factors identified as related to integrated motivation, at least in an adolescent population. Ongoing research seeks to address whether SDT-based interventions are also applicable to increase PA participation among adults (Jolly et al., 2009; Silva/ et al., 2008). The current study will investigate SDT principles in a population of adults, with a

focus on web-based MI delivery. Given that MI principles map on to the theoretical framework of SDT, systematic investigation of the potential for modifying motivations and behaviors such as PA through MI is warranted.

Self-Efficacy Theory

Self-efficacy is a central component of Bandura's (1986) SCT, which posits that human behavior is a product of the interacting factors between an individual, her environment, and the behavior itself. The interaction of these three factors, termed triadic reciprocity, ultimately predicts behavioral occurrence. An assumption of SCT is that human behavior is self-regulated. That is, individuals reflect on factors including specific goals, possible outcome expectancies, and perceived ability to achieve certain outcomes. In turn, these self-reflections serve to regulate behavioral occurrence. A main component of self-reflection often mentioned in the context of health behavior prediction is SE. According to Bandura, SE is an individual's belief that he can perform a specific task or behavior (Bandura, 1997). From a cognitive behavioral perspective, a person must believe that she is capable of a particular behavior for that behavior to occur (Bandura, 1997).

Self-efficacy theory for behavior change. According to Bandura (1977, 1986), four specific factors contributing to SE have been identified. Bandura (1977) explains that through social learning, individuals' efficacy expectations, which represent SE for a given behavior, can be influenced by therapeutically manipulating any or all of the four factors identified. The most important/powerful predictor of SE is past *performance accomplishments*, or mastery experiences. Past success in, or mastery of a specific task is associated with greater SE for future completion of that same task. *Vicarious experiences*

also contribute to SE beliefs. That is, if an individual acknowledges that a similar other (i.e., model or a proxy) is capable of performing a given behavior, then that individual is likely to believe that he can also successfully perform that behavior. *Verbal persuasion* is the third most powerful predictor of SE. Offering verbal support to someone who is not confident in her abilities can also enhance efficacy beliefs. Finally, *emotional arousal* contributes to SE. Enhancing positive physiological/psychological reactions by reducing anxiety and negative feelings related to a specific behavior will facilitate SE for a given behavior. As suggested earlier, enhancing an individual's SE for a given behavior serves to increase the occurrence of the associated behavior (Bandura, 1986; Bandura, 1977).

Self-efficacy theory and Motivational Interviewing. Developers of the MI counseling style acknowledge that an individual must believe that he is capable of a given behavior in order to engage in that behavior. Miller and Rollnick (2002) recognize that a person can want to change and be ready to change, but unless that person believes she is capable of change, behavior change will not occur. As previously mentioned, MI is often used as a way to increase SE in order to encourage behavior change (Miller & Rollnick, 2002).

The four SE enhancement techniques described by Bandura (1977, 1986) are typically applied during MI. Mastery experiences are discussed during MI to reinforce feelings of self-confidence given past success (Miller & Rollnick, 2002). Furthermore, barriers to future successes are discussed and addressed, and accurate goals are encouraged, all in an attempt to boost confidence in making successful behavior changes. Vicarious experiences are also discussed to reinforce feelings of confidence through

reflection on the success of others. Verbal encouragement is offered by reaffirming efforts and acknowledging success of the client. Sources of ambivalence are explored through discussion in order to encourage constructive strategies for working through uncertainties about behavior change, thereby enhancing self-confidence for change. Finally, during MI efforts are made to reinforce positive arousal related to behaviors, while at the same time reducing negative arousal or stress reactions. Positive arousal can be reinforced by facilitating self-reflection on positive behavioral experiences, whereas negative arousal or stress can be reduced by normalizing reactions such as discomfort associated with behavior change. Capitalizing on positive behavioral experiences and normalizing negative experiences further reinforces the perception of ability to continue to participate in a given behavior.

All or some of the above mentioned strategies are applied during MI to enhance SE for behavior change. Miller and Rollnick (2002) mention that SE support was included as a main component of the counseling style because this factor is consistently demonstrated as a salient predictor of behavior change. In the PA domain, investigations discussed below offer support for inclusion of SE in interventions geared at enhancing PA participation.

Self-efficacy theory for physical activity promotion. Specific to applications in the PA domain, according to SE theory a person will not engage in PA unless she believes that she is capable of engaging in PA (Bandura, 1997). Furthermore, a person with low SE for PA is unlikely to engage in PA. Research to date supports inclusion of SE as a key variable for predicting PA (McAuley, Courneya, Rudo0lph, & Lox, 1994; Sallis et al., 1986), with some support that SE can be enhanced to promote PA (Dishman

et al., 2005). While SE enhancement is part of the framework for MI, more research should be conducted to investigate the mechanisms and efficacy of MI for enhancing PA by way of PA-related SE enhancement.

Support for self-efficacy relating to physical activity participation. Consistent with the logic of Bandura (1977, 1986), preliminary research efforts in the PA domain suggest that SE is related to behavioral occurrence, including PA adoption. Sallis and colleagues (1986) studied whether or not SE was related to PA participation among a community sample of adults (n =759 women, 652 men), ranging in age from 20 to 74 years (M age not reported). Assessment of SE, measured by a four item SE questionnaire (Bandura, 1982), moderate PA adoption assessed by self-reported initiation of activities such as climbing the stairs instead of taking the elevator, and vigorous PA adoption assessed by self-reported initiation of activities such as jogging or running at least 10 miles per week (Sallis et al. 1985) were conducted at baseline and 1-year later.

As expected, results indicated that SE was a significant predictor of vigorous activity adoption among men ($F = 21.12$, $p = 0.004$) and women ($F = 25.84$, $p = 0.004$). Findings indicated that men were more likely to adopt vigorous intensity PA than women (i.e., 5% of women, and 11% of men; significance not reported), whereas women were more likely to initiate moderate intensity PA, compared to men (i.e., 34% of women, and 25% of men; significance not reported). Self-efficacy was a significant predictor of moderate intensity PA adoption among women ($F = 27.07$, $p = 0.007$), but not men. Taken together, these findings suggest that men may prefer to initiate PA at a more vigorous intensity, whereas women may prefer to initiate PA at a more moderate intensity. Also, regardless of gender differences in intensity preference, SE is related to

PA adoption. Specifically, these findings suggest that SE is a predictor of PA adoption at a moderate or vigorous intensity for women, and at a vigorous intensity among men.

In agreement with findings of Sallis and colleagues (1986), recent research supports the finding that SE is related to PA participation in the adult population (McAuley et al., 1994), where activity intensity is not taken into account. The focus of more recent research efforts is on identifying whether SE can be enhanced in order to increase PA. Several studies described below offer support for SE-based interventions to increase PA participation.

Support for self-efficacy applications to increase physical activity. Given the finding that SE is related to PA participation, several studies to date support that SE-based interventions can facilitate PA participation (Dishman et al., 2005; McAuley et al., 1994). One such study conducted by McAuley and colleagues (1994) demonstrated that a program geared at enhancing SE was successful to increase PA participation among sedentary men and women (n = 114) ranging in age from 45 to 65 years (M = 54.2). In this investigation, participants were randomly assigned to either a SE enhancement intervention group or an attentional control group, where both groups participated in PA programs. The PA program occurred 3 times per week for 20 weeks, and included walking 15 to 40 min each bout. Both groups attended bi-weekly sessions, which were geared at enhancing SE in the intervention group, and were informational in the comparison group. At baseline, and monthly thereafter, participants in both groups provided: (a) self-reported SE related to PA adherence which was assessed by a 10-item Adherence Efficacy questionnaire developed as part of the study; (b) PA adherence based

on records of attendance to the PA program; and (c) PA distance and duration which were as assessed by participant recorded daily logs of PA.

Results supported that the SE-based intervention was effective to facilitate PA, given that the intervention group exercised significantly more frequently ($F[1,112] = 6.648$, $p < 0.01$), for greater duration ($F[1.112] = 7.22$, $p < 0.01$), and for longer distances ($F(1.112) = 5.32$, $p < 0.05$) than participants in the attentional control group. Findings indicate that, inconsistent with expectations about the mechanisms of intervention effect, the intervention did not directly influence SE. However, consistent with expectations about the overall intervention outcome, SE contributed to increased PA participation ($R^2 = 0.04$, $p < 0.05$) in the experimental group. These preliminary findings suggest that although mechanisms are not apparent (i.e., the SE intervention did not increase SE), the SE intervention was successful for increasing PA participation.

More recent research offering insight as to factors which may mediate the mechanisms of SE enhancement on PA suggests that SE-based interventions can be effective to enhance both SE-related to PA and PA itself. Although the population of interest in the Dishman et al. (2005) study (adolescent girls) differs from the current population of interest (i.e., adult men and women), findings support SE-based interventions to enhance PA. Dishman et al. (2005) applied the LEAP intervention (details previously described) to enhance SE, measured by an 8-item self-efficacy scale for adolescents (Motl et al. 2004), as well as PA measured by a 3-day PAR log (Pate et al., 2003).

The intervention was found to have a significant indirect effect on SE, where the intervention had a significant direct effect on factors influencing enjoyment of PA

($\beta = 0.11$, $p < 0.05$), and the factors influencing PA enjoyment had a moderate effect on SE ($\beta = 0.33$, $p < 0.05$). Finally, SE had a small but significant direct effect on PA ($\beta = 0.16$, $p < 0.05$). The LEAP intervention also had an overall significant effect on PA participation (F [2,22] =3.54, $p = 0.046$). Authors suggest that increased PA participation observed following the LEAP intervention is attributable to the mediating effects of enjoyment, factors influencing enjoyment, and SE (Dishman et al., 2005). These findings support suggestions that an intervention can successfully increase PA by enhancing SE, at least among adolescent girls. It seems that the SE intervention may increase enjoyment of PA, which in turn may increase SE and PA participation. Notably, the effects of the LEAP intervention may not be attributed solely to SE modification, because the intervention influenced social cognitive factors besides SE.

Summary of limitations and implications of self-efficacy research. Research consistently demonstrates that SE is related to PA (Dishman et al., 2005; McAuley et al., 1994; Sallis et al., 1986). Further, there is support for the notion that interventions geared at enhancing SE can be applied to increase PA participation (Dishman et al., 2005; McAuley et al., 1994). Additional research is needed, however, to elucidate the mechanisms by which enhancing SE can enhance PA participation in the adult population.

While SE-based interventions for adults are related to increases in PA (McAuley et al., 1994), the mechanisms of intervention effectiveness are not entirely clear. That is, in the McAuley et al. 1994 study, the SE intervention was related to increased PA, but contrary to predictions, the SE intervention was not related to enhanced SE. And, although the Dishman et al. (2005) study shows that a SE-based intervention can enhance

SE, the study does not necessarily generalize to an adult population. Therefore, additional research investigating the cognitive mechanisms of SE-based interventions in an adult population are warranted.

Studies involving adults should focus on SE as well as enjoyment as mediating factors of PA participation. Furthermore, consistent with the Dishman et al. (2005) study, SE-enhancement is oftentimes not considered as a stand-alone intervention, but rather as one component of an intervention approach based in several theories. In addition to including enjoyment as a factor influencing PA participation, the current study will consider the utility of applying SE-enhancement, combined with other theoretically-based approaches as part of MI to increase PA among adults. The following section will describe TTM research which oftentimes includes SE as a target of behavior change interventions.

Transtheoretical Model

The TTM is a cognitive-behavioral model which includes six distinct stages of change (Prochaska, DiClement, & Norcross, 1992) depicted as occurring in a spiral fashion. The stages of behavior change from first to last along the spiral include: (a) *precontemplation*, during which an individual is not thinking about change, does not have intentions to change, and is not actively pursuing change; (b) *contemplation*, in which the individual is thinking about change, but not actively pursuing change; (c) *preparation*, in which the individual has made the decision to change and is in the process of preparing to change behavior; (d) a*ction*, in which the individual is actively engaged in behavior change; (e) *maintenance*, in which the individual has been successful in changing a behavior for six months or more and is in the process of maintaining behavior change,

and finally; (f) *termination*, in which the individual has been successful in changing behavior and there is no risk of relapse. Of note, the termination stage is often not included in the TTM secondary to the suggestion that it would be unlikely to achieve a state during which the risk of relapse is completely absent (Prochaska & Marcus, 1994). According to the TTM, the individual can enter the spiral at any stage and can cycle forward and/or backward (Prochaska et al., 1992).

The transtheoretical model for behavior change. It is accepted that behavior change theories such as the TTM, which were initially designed to encourage cessation of health-harming behaviors, are also applicable to encourage adoption of health-enhancing behaviors. Like MI, the TTM was originally developed in the substance abuse paradigm, with specific applications for decreasing health-harming behaviors (Prochaska et al., 1992). Both MI and the TTM have more recently been applied to increase PA as a health-enhancing behavior (Marcus & Simkin, 1993,1994). Persons in the precontemplation and contemplation stages of change will be enrolled in the current study, with a goal of moving those persons toward the action stage of change by applying MI. Constructs defined by the TTM that will be targeted during MI to facilitate stage progression include: (a) *processes of change*, (b) *decisional balance*, and (c) SE.

Within the TTM, *processes of change* reflect the underlying mechanisms of stage progression (Prochaska et al., 1992), which can be targeted during MI. The following represent the ten specific processes of change: (a) *consciousness raising*, during which an individual is thinking about a given problem or behavior; (b) *self-re-evaluation*, during which an individual is assessing behavior relative to problems or goals; (c) *self-liberation*, during which an individual is strengthening the commitment to change; (d)

counterconditioning, during which an individual is utilizing distraction, desensitization and/or encouragement to think positively in the case of a problem behavior; (e) *stimulus control*, during which an individual is altering the environment to promote the desired behavior and/or to avoid the undesirable behavior; (f) *reinforcement management*, during which an individual is utilizing operant rewards systems to alter the frequency of a given behavior; (g) *helping relationships*, during which an individual is relying on social support to facilitate behavior change; (h) *dramatic relief*, during which an individual is expressing feelings about a circumstance or behavior; (i) *environmental re-evaluation*, during which an individual is paying more attention to the environment and the influence that the environment has on behavior, and finally; (j) *social-liberation*, during which an individual is empowered to change behavior (Prochaska et al., 1992).

In addition to processes of change, stage progression is associated with *decisional balance* and SE (Marcus & Simkin, 1994). Decisional balance refers to a process of weighing the pros and cons of maintaining current behavior versus changing behavior, where if the pros for changing behavior outweigh the cons, there is a greater likelihood of behavior change (Marcus & Simkin, 1994). Self-efficacy, described in detail in the previous section, is also cited as a factor that contributes to the likelihood that an individual will progress through stages of change (Marcus & Simkin, 1994). That is, if an individual is confident in their ability to change behavior, they will be more likely to change that behavior.

With behavior change in mind, the purpose of the current study is to identify whether MI is a useful intervention to facilitate stage progression, and if so, to identify the underlying cognitive mechanisms of change. Process of change, decisional balance,

and SE will be measured to assess their respective roles as underlying cognitive mechanisms of stage progression. Accordingly, stage progression and related changes in PA participation will be assessed as a function of MI participation.

The transtheoretical model and Motivational Interviewing. Consistent with the population of interest in the current study, MI is geared toward individuals who are in either the precontemplation or contemplation stages of change (Miller & Rollnick, 2002). Individuals in the precontemplation or contemplation stage are not ready to change, and may express a certain amount of ambivalence or reluctance to change. During MI, ambivalence for behavior change is explicitly acknowledged, affirmed, and explored. The goal of exploring ambivalence is to move a person toward readiness to change behavior. Although Miller and Rollnick (2002) use TTM principles to guide MI delivery, research to directly assess the underlying mechanisms of stage progression and related behavior change has not yet been conducted. As such, a goal of the current study is to assess whether MI affects cognitions including processes of change, decisional balance, and SE related to PA.

The transtheoretical model for physical activity promotion. In line with the use of the TTM for facilitation of a range of health-enhancing behaviors, the model has been specifically targeted for application in the area of PA promotion (Jackson, Asimakopoulou, & Scammell, 2007; Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998). To promote PA within the TTM paradigm, individuals are classified into a stage of change which reflects activity status, at which time TTM-based interventions can be applied to increase PA. Transtheoretical model-based interventions specifically target processes of change (Prochaska et al., 1992), SE related to PA, and/or decisional balance

for PA (Marcus & Simkin, 1994). The TTM is applied to classify individuals into PA-related stages of change (Marcus et al., 1998; Marcus & Simkin, 1993; Schumann et al., 2002), to increase stage progression toward readiness to engage in PA (Jackson et al., 2007; Marcus et al., 1998), and to influence cognitive mediators of increases in PA (Marcus et al., 1998). Support for application of the TTM to enhance PA is offered below, followed by a discussion of the implications of research to date pertaining to the proposed study.

Support for physical activity stage classification. In an effort to justify application of TTM-based principles for PA enhancement, Marcus and Simkin (1993) studied whether stage allocation coincided with PA behavior among adults (n = 235; M[age] = 40.6 years, SD= 12.9 years, no range reported). Stage of change, measured by a five-item Stage of Exercise Behavior inventory developed as part of the Marcus & Simkin (1993) study, was compared to exercise behavior measured by a 7-day PAR questionnaire (Blair. et al., 1985). Results indicated that participants in the action/maintenance stages engaged in significantly more minutes of activity than participants in the precontemplation or contemplation stages of change for vigorous activity, ($F(2, 218) = 20.57$, $p < 0.01$) and moderate activity ($F(2, 218) = 9.09$, $p < 0.001$), suggesting that the TTM is a valid way of assessing stage of change pertaining to PA behavior.

The aforementioned findings have since been replicated, focusing on differences in stage of change for mild activity, in addition to moderate and vigorous activity. Schumann et al. (2002) investigated adults (n = 346) ranging in age from 18 to 75 years (m = 42.8) as well as other age groups, to determine whether stage assignment, measured

by a five-item Stages of Exercise Behavior inventory (Marcus & Simkin, 1993) reflected adoption of various intensities of PA as measured by the Leisure-time Exercise questionnaire (Godin & Shephard, 1985). Results of the study indicated that stage of change was significantly correlated with strenuous ($r = 0.46$, $p < 0.001$), moderate ($r = 0.41$, $p < 0.001$), and mild exercise ($r = 0.14$, $p < 0.001$). In addition, there was a stepwise increase in mean activity comparing early stages of change to action and maintenance for all activity levels. However, MANOVA testing indicated that differences in activity depending on stage allocation were only significant for strenuous ($F = 25.47$, $p < 0.005$, $\eta^2 = 0.28$) and moderate ($F = 20.42$, $p < 0.05$, $\eta^2 = 0.19$), but not mild, activity. These findings support the notion that stage of change coincides with PA behavior among adults, with the exception of mild intensity activity which was not accurately reflected by stage classification in the current study. Given the findings of Marcus and Simkin (1993) as well as Schuman et al. (2002), it appears that the TTM can be applied to assess stage of change pertaining to PA. Since the TTM stages map onto PA behavior, TTM-based interventions are examined to assess efficacy for PA enhancement.

Support for transtheoretical model applications to increase physical activity.

Several studies to date support the inclusion of TTM principles to facilitate stage progression and enhance PA participation (Jackson et al., 2007; Marcus et al., 1998). An early study conducted by Marcus et al. (1998) applied an individually-tailored TTM-based intervention to enhance PA participation. Sedentary adults (n =150; M[age] = 44.3, SD= 10.8, no range reported) were randomized into either an individually-tailored intervention or a standard treatment group. Participants were in either the

precontemplation/contemplation ($N = 40$), preparation ($N = 61$), or action ($N = 46$) stage of change at baseline, which was assessed by a five-item Motivation for Stages of Exercise Behavior inventory (Marcus, Rossi, Selby, Niaura, & Abrams, 1992). Notably all participants were mailed surveys which they completed and then returned by mail. Members of the intervention group were mailed individualized feedback specific to readiness to change, SE as measured by a five-item Exercise Self-Efficacy instrument (Marcus, Selby, et al., 1992), and processes of change as assessed by 40-items on the Motivation for Stages of Exercise Behavior inventory (Marcus, Rossi, et al., 1992). In addition to individualized feedback, individually-tailored self-help manuals were generated that were based on stage of change, processes of change, SE, and decisional balance as assessed by a 16-item Decisional Balance inventory (Marcus, Rakowski, & Rossi, 1992). Members of the standard treatment condition were provided with self-help manuals that were not individually-tailored but included information about PA participation for health. Among all participants, self-reported PA information was gathered as assessed by 7-Day Physical Activity Recall (PAR) (Blair et al., 1985).

Results supported that the TTM-based intervention was effective in facilitating PA participation. At 6-months post-baseline, both intervention and standard treatment groups reported significant increases in PA compared to baseline ($F[1,148] = 172.68$, $p < 0.01$). There was a significant group by time interaction at 6 months ($F[1,148] = 7.31$, $p < 0.01$). Given this significant interaction, and observance of greater minutes of PA per week in the individually-tailored intervention condition ($M = 151.4$) compared to the self-help condition ($M = 97.6$), it appears that the intervention was successful to increase PA over time. Intervention participants also were significantly

more successful than self-help participants in achieving CDC/American College of Sports Medicine (ACSM) guidelines for PA participation (χ^2 {1} = 11.3, p < 0.01). Inclusion of SE and processes of change as cognitive mechanisms of change were also supported. Although there were no significant differences between groups, SE increased significantly within both groups (F [3,146] = 2.8, p < 0.05), as did reported pros related to exercise (t[149] = 2.8, p < 0.05) and cognitive processes of change (t[149], =2.9, p < 0.01). Of interest, increases in behavioral processes of change were significantly more pronounced in the intervention group over time compared to the standard care condition over time (F [3,145] = 6.6, p < 0.01). Overall, findings of Marcus et al. (1998) suggested that stage-matched, mailed TTM materials, are effective to enhance PA participation.

Highlighting an alternative to mail-based intervention delivery, Jackson et al. (2007) implemented face-to-face stage-tailored interventions to enhance PA participation. Adults (n= 34) diagnosed with Type II Diabetes, ranging in age from 34 to 75 years (M[intervention group] = 58.35, M[control group] = 62.06), were randomly assigned to either a 20-30 minute TTM-based exercise consultation or a no-treatment control condition. Researchers indicated that participants self-assessed stage of change based on definitions of activity levels at specific stages. Although participants in the precontemplation stage were not successfully recruited into the study, a portion of the participants were in the early stages of change (i.e., contemplation, 17.5% of control group, 29.4 % of TTM group; and preparation, 29.4% of control group, 23.5% of TTM group) and the remainder of the participants recruited were in more advanced stages of change (i.e., action, 23.5% of control group, 11.5% of TTM group; and maintenance

29.4% of control group, 35.3% of TTM group). Members of the TTM condition underwent stage-tailored counseling, which was delivered by an MI-trained clinician. Counseling for participants in the contemplation stage involved enhancing motivation to change and discussing benefits and barriers to PA. Notably, stage-matched counseling approaches were provided for later stages of change as well, which are not pertinent to the current investigation.

Consistent with study predictions, the face-to-face TTM intervention was effective to facilitate increases in PA, as assessed by a version of the Physical Activity questionnaire (PAQ) which was adapted from a Scottish version (Lowther, Mutrie, Loughlan, & McFarlane, 1999). At 6-weeks post-intervention, there was a significant increase in minutes of self-reported PA in the TTM group ($p < 0.01$, means of PA pre/post for groups not explicitly reported) but not the control group, compared to baseline values. Corroborating increases in PA, participants in the TTM group also progressed in stage of change given that those participants who were previously in the contemplation stage (29.4%) reported being in later stages following the intervention (35.5% in preparation, 29.4% in action, 35.3% in maintenance). Conversely, among participants in the control group there was no clear trend in stage progression following the intervention (11.8% in precontemplation, 29.4% in preparation, 29.4% in action, 29.4% in maintenance). Findings of Jackson et al. (2007) suggest that an MI-consistent face-to-face TTM intervention is effective to increase PA, and to facilitate stage progression.

Summary of limitations and implications of transtheoretical model research.

Despite support for the implementation of TTM-based interventions to increase PA, several limitations of research to date should be addressed. One limitation is that studies have relied on self-reported PA assessment tools, without including objective PA assessment (Jackson et al., 2007; Marcus et al., 1998; Marcus & Simkin, 1993; Schumann et al., 2002). A second limitation is that come studies have relied on TTM stage allocation to assess PA outcomes. Because mild intensity activity may not be captured through TTM stage allocation (Schumann et al., 2002), the proposed study will include both objective and subjective PA assessment to ensure that possible changes in mild intensity PA among under-active or inactive adults are detected.

In order to target individuals who are insufficiently physically active, efforts were made to recruit participants in the prectontemplation and contemplation stages of change. Among the limitations associated with recruiting persons in later stages are that these individuals are already taking steps to engage in PA, and would not necessarily benefit from an intervention. In the Jackson et al. (2007) study, for example, none of the participants were in the precontemplation stage and many were already maintaining PA for 6 months or more at baseline. Given the characteristics of the sample, individuals who may have benefited most (i.e., precontemplators) were excluded, whereas participants who presumably would not benefit (i.e., maintainers) were included. Given that participants in the precontemplation and contemplation stages of change are not yet taking steps to become active, efforts were made to recruit those individuals for participation in the current study.

Regardless of stage of change at baseline, because of lack of assessment of cognitive mediators of change in the Jackson et al. (2007) study, it is not possible to assess mechanisms of intervention effectiveness. Developing a better understanding of the mechanisms of PA change would be useful to refine intervention delivery. The Marcus et al. (1998) study does take into account cognitive mediators, and suggests that processes of change and SE may mediate increases in PA when applying a TTM-based intervention. However, decisional balance is not investigated as a mediating cognition, despite theoretical support for inclusion. The current study set out to clarify the role of mediating cognitive factors which correspond with both stage progression and behavior change following MI.

The final issue which should be considered is that although implementation of face-to-face interventions requiring one-on-one clinician attention are effective to facilitate stage progression and PA participation (Jackson et al., 2007), face-to-face delivery might not be necessary. Marcus et al. (1998) suggest that mail-based delivery is effective to influence stage progression and PA, and along the same line of inquiry, internet delivery of TTM-based principles for PA enhancement is an emergent focus of recent research (Marcus et al., 2007). The current study addressed whether MI affected stage progression, related cognitions, and PA behavior using web-based delivery to enhance the practicality of including a larger population.

Cognitive Dissonance Theory

Informed by social psychology, cognitive dissonance theory describes the state of discomfort, termed *cognitive dissonance,* that arises when an individual's thoughts and actions/behaviors are inconsistent (Festinger, 1957). According to this theory, if an

individual acts in a way that is inconsistent with her thoughts, beliefs, values or goals, then she will feel uneasy. Individuals do not prefer this state of discomfort and will therefore work to reduce cognitive dissonance by either changing one's thoughts or actions in such a manner that thoughts and actions become consistent (Festinger, 1957).

Cognitive dissonance theory for behavior change. According to Festinger (1957), cognitive dissonance theory has implications for changing behavior. For example, an individual who believes that health is important but does not behave according to his physician's advice to be healthy, may experience cognitive dissonance. The incongruence between thoughts and actions in the given example can be changed by either: (a) changing thoughts so that health is no longer important, or perhaps by deciding that the physician's advice would not lead to good health; or (b) by changing actions to follow the recommendations of the physician to achieve health. Given that individuals are inherently driven to minimize dissonance and associated discomfort, creating a sense of realization of dissonance has applications for motivating change in thoughts and/or actions.

Cognitive dissonance and Motivational Interviewing. Motivational Interviewing involves facilitating awareness of dissonance (Miller & Rollnick, 2002). The general idea behind increasing dissonance awareness is that if an individual realizes that his thoughts and actions are inconsistent, he can be guided to change behavior. Individual thoughts and actions are acknowledged, and inconsistency is discussed in such a way that highlights the discrepancy. As previously mentioned, the process of encouraging reflection on inconsistencies between thoughts and action is termed "creating a discrepancy" (Miller & Rollnick, 2002). The goal of creating a discrepancy is

to guide the individual to make positive behavioral changes that would eliminate dissonance (Draycott & Dabbs, 1998). In order to create a discrepancy, specific techniques are applied during MI, which include encouraging reflection on thoughts and actions or completing a balance sheet to identify the pros and cons of behavior stagnancy versus behavior change. While specific techniques applied during MI are based in cognitive dissonance, there is a lack of research to systematically investigate the role of creating a discrepancy and facilitating resolution of dissonance through behavior modification.

In contrast to theories previously reviewed, cognitive dissonance theory is not investigated with respect to MI *or* with respect to PA more generally. This theory evolved from social psychological ideology and is not frequently measured with respect to health behaviors. Along these lines, in the current study cognitive dissonance is not considered as a measurable outcome variable, but rather as an underlying factor further influencing cognitions included in the proposed model.

Summary of Theories of Behavior Change and Motivational Interviewing

All of the cognitive behavioral theories described in the preceding sections are, as previously mentioned, included as the proposed theoretical mechanisms of MI. Self-determination theory, SE theory, the TTM, and cognitive-dissonance theory map onto the MI approach to enhancing readiness, willingness, and perceived ability to change. Overall, with the exception of research on cognitive dissonance theory, there is ample support to suggest that theories mapping onto MI can be applied to enhance PA participation.

Meta-analysis findings suggest that MI is efficient and effective for delivery across a variety of health behaviors, including PA (Dunn, Deroo, & Rivera, 2001). Authors note that there are multiple areas warranting additional research to assess MI efficiency and efficacy, including the need to consider underlying mechanisms (Burke, Arkowitz, & Menchola 2003; Dunn et al., 2001). In addition, given the preliminary empirical support generated for MI there is increasing focus on clinical applications including PA enhancement.

Rationale for Motivational Interviewing for physical activity promotion. A number of papers have emerged which give clinicians, including physicians, advice for how to incorporate MI into health care visits as a brief intervention to promote PA participation (Britt et al., 2004; Hettema et al., 2005; Huang, 2005; Scales & Miller, 2003; Shinitzky & Kub, 2001). Suggestions for applying MI in clinical settings are based on principles previously established by Miller and Rollnick (2002). These suggestions are directed toward both primary care physicians and specialists to increase PA participation among either the general population not satisfying PA recommendations (Huang, 2005; Scales & Miller, 2003), or persons with disease-specific PA needs such as persons with cardiovascular disease (Hancock, Davidson, Daly, Webber, & Chang, 2005) or fibromyalgia (Jones et al., 2004). Motivational Interviewing was formerly applied as a stand-alone intervention which oftentimes served to facilitate compliance with a separate, more involved intervention (Miller & Rollnick, 2002). However, more recent adaptations of MI can be incorporated into doctor visits or as an addition to ongoing health interventions to modify health-behaviors. The recent diversification of applications for

MI as a brief intervention specific to increasing PA participation highlights the need for research to clarify the potential broad utility of the technique.

Although the majority of research to date is related to substance abuse, there is recently an increase in research to investigate MI for PA (Burke et al., 2003; Dunn et al., 2001). Furthermore, there has been recent support for the implementation of MI to facilitate PA. The current body of literature implicating MI for PA promotion varies considerably in terms of delivery protocol. Motivational Interviewing was initially supported using face-to-face, telephone, or face-to-face plus telephone delivery. To form the basis for applying MI to enhance PA, research reviewed is organized by delivery modality where face-to-face delivery research is reviewed first, followed by telephone delivery research, and then face-to-face plus telephone delivery. Research regarding web-based delivery of MI is in the early stages, and is considered separately in a later section. Pertinent to the current study, the efficacy of MI is supported regardless of delivery modality, although the mechanisms of effect are poorly understood.

Support for face-to-face delivery of Motivational Interviewing to increase physical activity. A pioneer study by Harland, White, Drinkwater, Chinn, Farr, and Howel (1999) supported the implementation of one or more 40-minute MI sessions as a stand-alone face-to-face intervention to increase PA participation. A large sample of economically disadvantaged adults (n = 523) ranging in age from 40 to 64 years (M not reported) were recruited from general practice when seen for routine surgeries. Participants were randomized into one of five groups: (a) one session of MI; (b) one session of MI and 30 vouchers for an area fitness facility; (c) six sessions of MI over 12 weeks; (d) six sessions of MI and 30 vouchers; and (e) assessment only control.

Results indicated that MI was effective to increase PA as assessed by self-reported number of PA sessions in the past 4-weeks as assessed on the British National Health Fitness Survey (Sports Council, Health Education Council, 1992). That is, at 12-weeks post baseline participants in the MI groups collectively demonstrated a significantly higher proportion (38%, $n = 123$) of increases in PA compared to the control group (16 %, $n = 13$; $p = 0.001$). Further, when broken down by activity intensity, the MI groups collectively participated in significantly more moderate (i.e., expending 5-7.5 kcal/min for at least 20 minutes) and vigorous (i.e., expending greater than 7.5 kcal/min) PA (30% [moderate], n= 98; 29% [vigorous], $n = 94$) compared to the control group (13% [moderate], $n = 11$, $p = .002$; (11% [vigorous], $n = 11$; $p < 0.001$). Notably, there were no differences in PA participation based on number of MI sessions, addition of vouchers, or an interaction of sessions and vouchers. The researchers point out that PA outcomes were not durable at one-year post-intervention, noting that perhaps including an economically disadvantaged population inhibited continued PA due to limited resources for accessing fitness facilities. Nonetheless, preliminary findings collectively suggest that face-to-face MI at a frequency of one to six sessions can be applied to facilitate increased PA participation, at least short-term, among economically disadvantaged adults.

Research by Carels et al. (2007) focusing on populations which are not exclusively economically disadvantaged also supports face-to-face delivery of MI to enhance PA participation. In an investigation of MI as part of a stepped-care behavioral weight loss program (BWLP), adults ranging in age from 24 to 55 years ($M = 48.3$) who were obese, sedentary, and not meeting weight loss goals through BWLP ($n = 55$) were

assigned to either stepped-care BWLP plus MI, or a matched comparison stepped care BWLP without MI. Motivational Interviewing sessions occurred weekly for 45-60 minutes, and consistent with the stepped-care approach, MI was discontinued if weight loss goals were met (average number of sessions = 5.4, range = 1-15).

Consistent with expectations, participants in the BWLP plus MI group lost significantly more weight than the matched BWLP comparison group ($F[1,33] = 43.52$, $p < 0.01$), and consistent with this finding participants in the BWLP plus MI group participated in significantly more minutes of PA per week based on self-reported minutes of PA in a non-standardized log than participants in the matched comparison BWLP group which did not receive MI ($F[1, 31]= 2.36$, $p = 0.05$). These findings suggest MI-facilitated satisfaction of weight loss goals, likely through increased PA participation among sedentary, obese adults in a BWLP.

Taken together, the findings of Harland et al. (1999) and Carels et al. (2007) show preliminary support for the application of face-to-face MI to increase PA participation. Face-to-face delivery seems useful but may not always be feasible. Alternatives to face-to-face intervention including telephone delivery are therefore considered.

Support for telephone delivery of Motivational Interviewing to increase physical activity. Research supports MI applications using telephone delivery instead of face-to-face interventions. Kremen et al. (2006) applied a brief MI-based telephone intervention, which was focused on facilitating dietary and PA changes in order to improve low-density lipoprotein cholesterol (LDL-C) levels, among Caucasians recruited from livestock auctions ($n = 24$) ranging in age from 39 to 67 years ($M = 52.8$). All participations received educational materials including a description of cholesterol and

actions to lower cholesterol, and an exercise plan. Participants were further assigned to get one of two 30-45 minute follow-up phone calls, two weeks post-intake, which was either MI-based or scripted educational material.

Consistent with predictions, there were significant decreases in total cholesterol in LDL-C as measured by a fasting lipid profile at 3 months post-intervention, compared to baseline in the MI group (χ^2 (1,12) = 7.36, p <0.01), but not in the educational comparison group. Conceivably PA increased given that the target of the MI was to increase PA in order to lower LDL-C, but because PA was not directly assessed it is not entirely clear whether PA did in fact increase. Authors did measure increases in VO_2 max as estimated using the Rockport Walk Test (Kline et al., 1987) and found approximately 10% increase in cardio respiratory fitness in each group, although increases were not significantly different between the two groups. Despite lack of clarity regarding whether MI increased PA, the Kremen et al. (2006) study provides preliminary support that one very brief MI session over the telephone may be sufficient to facilitate health-enhancement.

Clarification of whether telephone-based MI can have an impact on PA as an outcome of interest is provided through a study conducted by Ang et al. (2007). In an investigation of whether MI was useful to encourage PA to alleviate fibromyalgia syndrome symptoms, women (M [age] = 52.9 years, SD = 9.1, range not reported) were recruited from medical practices and were excluded if they had engaged in moderate exercise three or more times per week during the past 6 months (n = 19). Using a quasi-experimental design without a comparison group, all participants were first given an exercise prescription and informed of the benefits of exercise as treatment for

fibromyalgia. Participants were then enrolled in supervised exercise and were coached in how to increase exercise duration and intensity over the course of several weeks. The MI component was conducted over the telephone, where six sessions lasting approximately 25- minutes each occurred between weeks 3 and 12 of the exercise program.

In addition to assessing fibromyalgia symptomology as a primary outcome, PA participation was examined using non-standardized self-report methods whereby participants stated the number of days and minutes per week of engagement in moderate or vigorous exercise over the course of the previous 7-days. Notably, it is not clear whether self-report measures were conducted over the telephone or in person. Consistent with predictions, findings indicated that the proportion of participants reporting 30-minutes or more of PA per week increased significantly from 15% at baseline to 53% of the participants at 30-weeks post-intake ($p < 0.01$). In addition, the total number of exercise minutes per week increased significantly from baseline (0 minutes) to 12-week assessment (16 minutes, $p = 0.004$), and again from 12 weeks (i.e., 16 minutes) to the 30-week (i.e., 32 minutes) assessment ($p = 0.001$). These findings suggest that PA may be enhanced through delivery of telephone-based MI participation. Taken together, findings of Kreman et al. (2006) and Ang et al. (2007) support the implementation of telephone delivery of MI to enhance PA participation.

Support for face-to-face plus telephone delivery of Motivational Interviewing to increase physical activity. As would be expected given support for application of face-to-face or telephone MI independently, a combined face-to-face plus telephone delivery of MI was effective to increase PA participation among adult cancer survivors, ages 18 years and older (*m* and range not reported), who were currently not active but planned to

initiate PA (n =56) (Bennett et al., 2007). Whereas Ang et al. (2007) did not include a control or comparison group, Bennett and colleagues used a randomized controlled trial. The Bennett et al. (2007) study included an MI group, which participated in one face-to-face MI session at intake, and two follow-up MI sessions over the telephone at 2-and 4.5-months post intake. A control group that did not include MI materials was asked to maintain current PA levels and were given phone calls at the same intervals as the MI group.

Although participants in the MI group were less active than the control group at intake, as assessed by the Community Healthy Activities Model Program for Seniors (CHAMPS) PA questionnaire (Stewart et al., 2001), at 6-months participants in the MI group participated in significantly more PA than the control group (χ^2 (1,51) = 81.55, $p < 0.01$. Researchers also found that SE as assessed by a six item scale (Nigg & Riebe, 2002) was related to increased PA in the MI but not the control group (β = 121.35, $p < 0.01$). Taken together, these findings suggest that MI delivered face-to-face in combination with telephone calls is related to increased PA participation. Although the researchers did not investigate the impact of MI on SE, given that SE was related to increases in PA in the intervention group, this variable warrants further consideration.

Summary of findings and limitations and implications of Motivational Interviewing research pertaining to physical activity. Despite support for application of MI to enhance PA using face-to-face (Carels et al., 2007; Harland et al., 1999), telephone (Ang et al., 2007; Kremen et al., 2006), and face-to-face plus telephone delivery (Bennett et al. 2007), additional research is needed to address limitations related to population selection and study design. Findings of studies to date may not generalize to a general

adult population given focus on specific subgroups such as persons who are economically disadvantaged (Harland et al., 1999),obese and enrolled in a BWLP (Carels et al., 2007), limited to Caucasians (Kremen et al., 2006), women with fibromyalgia (Ang et al., 2007), or cancer survivors (Bennett et al., 2007). In order to address inactivity and under-activity in a more general sample, the proposed study included adults recruited through primary care.

In addition to possible lack of generalizeability of findings to less specific populations, findings to date should be interpreted with caution due to inherent design limitations. Specifically, because research on MI for PA is preliminary in nature, oftentimes the samples are relatively small (Ang et al., 2007; Bennett et al., 2007; Kremen et al, 2006) and there are not sufficient control groups to rule out possible confounds (Ang et al., 2007; Carels et al., 2007). The current study attempted to obtain a larger sample to build confidence in the finding that MI can enhance PA participation. Further, studies to date oftentimes do not measure PA using standardized assessment tools because PA is not a primary outcome of interest (Carels et al., 2007; Kremen et.al., 2006). The current study assessed the efficacy of MI to increase PA using standardized assessment of PA.

In addition to building on preliminary findings regarding the efficacy of MI for PA participation, research is needed to understand the mechanisms of MI and to further explore delivery modality. Additionally, although face-to-face, telephone, and face-to-face plus telephone delivery of MI are supported, there is growing interest in considering whether web-based delivery would be effective as well. The current study investigated

whether theoretically-defined cognitive variables are influenced by MI using web-based MI delivery.

Web-Based Interventions for Physical Activity Promotion

A progressive approach toward enhancing PA participation may require integrating concepts from several concurrent lines of research. Findings of research in the areas of MI for PA, web-applications for PA promotion, and web-based MI for PA promotion can be considered collectively to inform intervention development. Emergent interventions seek to optimize efficiency, efficacy, and practicality of approaches to promoting PA. Recent research suggests that theoretically-based web interventions, which may be more accessible than face-to-face or telephone interventions, are effective to enhance PA participation (Carr et al., 2007; Marcus, Lewis, Williams, Whiteley et al. 2007; Napolitano et al., 2003; Sciamanna et al., 2002; Woolf et al., 2006).

One web-based delivery format which reflects theoretical principles discussed in previous sections, and is likely to be efficient in that the intervention is brief and can be widely accessed with limited face-to-face contact and cost is MI (Webber et al., 2008). Web-based adaptations of MI which are shown to be effective have goals of attenuating health behaviors including smoking (Woodruff et al., 2007) and alcohol use (Williams et al, 2009) as well as facilitating PA as part of weight management (Webber et al., 2008) and stress management (Chiauzzi et al., 2008). Research on applications of MI for enhancing PA in a web-based format is very limited, but supports the need for further consideration to inform delivery efforts.

Support for theoretically-based web interventions for physical activity promotion. To establish that web-based interventions can be applied to increase PA participation, a series of studies by Sciamanna et al. (2002) and Napolitano et al. (2003) included health-care workers not meeting guidelines for PA set forth by the CDC. Participants were randomized into either a wait list control condition (n =35) or a theoretically-based web intervention (n = 30, age range = 18 to 65 years, M = 41.6). Participants in the intervention group were prompted weekly for 12 weeks to access a website which applied SCT (Napolitano et al., 2003).

Consistent with expectations, Napolitano et. al. (2003) found that at one month post baseline, the internet group participated in significantly more minutes of moderate intensity PA as assessed by Behavioral Risk Factor Surveillance Survey (BRFSS) inventory (Jones et al., 1999) (M = 98.33, SD = 58.1) compared to the control group (m = 96.82, SD = 93.7, F[1,54] = 5.79, p<0.05) . Further, participants in the internet condition also engaged in significantly more minutes of walking (M = 87.29, SD = 53.9) compared to the control condition (M = 83.79, SD = 121.1, F [1,54] = 12.1, p < 0.001). There was also a significant increase in minutes walked within the intervention group based on comparison of one month to three month assessments (M = 112, SD = 75.7, M = 98.33, SD = 53.9, respectively; F [1,48)] = 5.2, p < 0.05). At three months post baseline, participants in the web intervention group were at higher stages of motivational readiness as assessed by a PA stage of change inventory (Marcus, Rakowski, et al., 1992) compared to baseline (χ^2 (1, N = 52) = 6.45, p < 0.01). Results of the Napolitano et al. (2003) study provide some of the first empirical support that an internet intervention can increase PA participation, as well as readiness for PA participation.

Building on preliminary findings by Napolitano et al. (2003), a study by Marcus, Lewis, Williams, & Whiteley et al. (2007) provides additional support that web-based interventions are effective to increase PA through inclusion of a large sample of sedentary adults (n = 245; age range = 18 to 65 years, M age not reported) recruited through newspaper advertisements. Participants were randomized to one of three conditions: (a) a theoretically-based web-site, which involved one month of weekly e-mail prompts to log into a web-site based on TTM and SCT; (b) a tailored print intervention, which included similar motivationally-tailored information as the web-based condition in print form; or (c) or a standard web intervention, which involved prompting participants to access several non-tailored and non-interactive PA-related Internet sites.

Although within-group differences were not assessed, median minutes of moderate/vigorous intensity PA per week as assessed by 7 day PAR interviews (Blair et al., 1985) increased from baseline values of 0 to 10 minutes of PA participation for all groups to: (a) 120 minutes in theoretically-based web-site group; (b) 112.5 minutes in the tailored print group; and (c) 90 minutes in the standard web group at 6 months post intervention. Despite a lack of significant between group differences, the observed increases in PA suggest that the web group and other conditions may have practical merit for increasing PA and warrants further examination (Marcus, Lewis, Williams, Dunsiger et al., 2007). While Napolitano et al. (2003) and Marcus, Lewis, Williams, & Dunsiger et al. (2007) rely on work-place facilitated or newspaper advertisements to recruit participants, additional research considers whether a physician referral scheme could be used to enroll participants (Woolf et al., 2006).

A study by Woolf, Krist, Johnson, Wilson, Rotemich, et al. (2006) included a sample selection process that would lend more directly to application in a health care setting due to utilization of a physician referral scheme. Adults (n = 932) who were predominantly under the age of 50 years (age range and m not reported) were referred to participate in a web-based intervention targeting multiple health behaviors. Participants were referred on the basis of engaging in some "unhealthy" behaviors as per physician assessment, and were therefore not necessarily insufficiently physically active. Participants were non-randomly assigned to either the "My Healthy Lifestyle" (MHL) website, which consisted of behavioral questionnaires, a library of resources tailored to the individual, links to external health websites, and physician advice; or a control condition which involved viewing a "static" health-related website.

Results pertaining to PA as assessed by two questions asking about number of days participating in light or moderate activities for at least 30 minutes, and vigorous activities for at least 20-minutes (Woolf et al., 2006) indicated that there was a trend toward increased light to moderate PA behavior in both intervention and control groups (p = 0.10) (Woolf et al., 2006). Additionally, based on PA stage of change inventory (Woolf et al., 2006), the MHL web-intervention group demonstrated significantly greater increases in percent of participants who showed stage advancement from pre-action to action stages of change at 1-month post intervention (21%) compared to the comparison group (5%, p = 0.02). These findings provide support that individuals may be successfully referred through primary care to a web-based PA intervention in order to enhance readiness to engage in PA, and possibly also to increase PA behavior. Given that the PA change observed was not statistically significant, assessing a web-based

intervention with strong methodology, including objective assessment of PA, is warranted to more precisely quantify changes in PA.

In a two part study by Carr et al. (2008), PA was assessed using pedometers among sedentary, overweight adults ranging in age from 18 to 65 years [n =17 (part 1); n = 32 (part 2), M age = 49.4 (control group), 41.1 (internet group)]. Following recruitment through newspaper advertisements and e-mail messages, participants were randomly assigned to "Active Living Every Day" (ALED)-internet, ALED-classroom, traditional exercise prescription or intent-to-treat control to assess efficacy within the conditions. Both ALED programs were based on the TTM and SCT, and were 16 weeks long, but ALED-classroom participants met in small groups while the ALED-internet participants were prompted by e-mail weekly to log-in to complete sessions.

The first part of the study assessed number of steps taken using YAMAX SW – 200 pedometers, and findings indicated that there was a significant increase in mean steps per day in the ALED-internet group comparing baseline to 16 weeks post-intervention (7215 ± 869, 9482 ± 804, respectively, $p < 0.05$). Comparable increases in steps per day were seen in the ALED - classroom group from baseline to post-intervention (6322 ± 669, 8690 ± 985, respectively, $p < 0.05$), as well as in traditional exercise prescription groups comparing baseline to post intervention (7556 ± 604, 9668 ± 696, respectively, $p < 0.05$). Consistent with expectations, significant changes were not observed in the control group form baseline to post-intervention (7206 ± 676, 6819 ± 800, respectively) (Carr et al., 2008). These findings indicate both internet and face-to-face programming contribute to significant increases in steps per day, whereas participants in the control group did not show significant increases in steps per day.

The second part of the Carr et al. (2008) study also demonstrated that the ALED – internet participants engaged in significantly more mean steps per day when comparing baseline to post-intervention (6614 ± 388, 7999 ± 439, respectively, $p < 0.05$) whereas control participants did not increase PA from baseline to post-test (6862 ± 641, 7678 ± 388, respectively). Although there were not significant differences between the ALED groups and the control group, as would be expected given increases in PA, participants in the ALED – internet group showed significant improvement in metabolic indicators from baseline to post-test as assessed by fasting venous blood sampling, including triglycerides (161 ±16 mg/dL, 108 ±14 mg/dL, respectively, $p = 0.01$). Participants in the ALED-internet group also showed significant improvement in coronary risk ratio calculated as a function of total cholesterol (mg/dL)/high-density lipoprotein (HDL) (mg/dL) from baseline to post-test (5.1 ±0.3, 4.1 ± 0.3, respectively, $p = 0.04$) (Carr et al., 2008). Notably there were not significant changes for triglycerides or coronary risk ratio in the control group. Therefore, improvements in cardiac function mentioned indirectly suggest that increases in PA are attributable to participation in the ALED-internet group. Therefore, findings of Carr et al. (2008) provide further support that theoretically-based web interventions can be applied to increase PA participation among adults.

Support for Motivational Interviewing web interventions for physical activity promotion. Given initial support for web applications, MI is proposed as a style to guide intervention delivery and content. Two studies which focused on facilitating health-enhancing behaviors provide preliminary support that MI could be used to increase PA in a web-based format (Webber et al., 2008). A recent pilot investigation conducted by Webber et al., (2008) was conducted to determine whether web-based MI groups would

yield improvements in weight management among adult overweight women ranging in age from 22 to 65 years (n =20, M age not reported) recruited through a University e-mail service. Women participated in either a group that received two online group sessions of MI, or a group that attended two online sessions of MI plus an added online discussion forum. The online sessions lasted one hour, and were guided by a MI trained student. In both groups, were e-mailed behavioral weight loss lessons weekly for 8 weeks.

Although PA was not assessed directly, both groups demonstrated significant decreases in self-reported weight (2.7 +/- 2.9 kg in the MI group; 1.5 +/- 2.2 kg in the MI plus discussion group, $p < 0.01$) post intervention. No significant differences between groups were recorded. In both groups, weight loss was significantly related to autonomous motivation based on the Treatment Self Regulation Questionnaire (Levesque et al., 2007). It is not clear whether either group experienced increased autonomous motivation due to their respective interventions. Additional research is needed to determine whether autonomous motivation can be affected by MI, and whether autonomous motivation changes mediate behavior change. Further, although it is unclear whether decreases in weight are attributable to PA or some other factor, these findings suggest that web-based MI may have a beneficial impact on weight loss behaviors and additional research is needed to clarify the possibility of applying MI to enhance PA. Notably, authors mentioned that some of the participants reported feeling uncomfortable with group discussions, and therefore individualized MI sessions should be considered further.

A study conducted by Chiauzzi, Brevard, Thum, Decembrele, and Lord (2008) considered individual rather than group-based MI. An interactive website called

"MyStudentBody – Stress" encouraged appropriate stress management through activities including increased PA among college students ranging in age from 18 to 24 years (n = 240, M age not reported) who were recruited from a public university. Students were randomized to either: (a) the interactive website which was consistent with the MI in that it included tailored, individualized motivational feedback to encourage self-reflection; (b) a standard text-based web program with health information; or (c) a no treatment control group which only completed surveys.

Physical activity was assessed along with other stress management behaviors by a subscale of the Health-Promoting Lifestyle Profile II (Walker, Sechrist, & Pender, 1987) at baseline, and then 1-, 3-, and 6-months post baseline. Findings indicated that there was a significant group by time interaction for participation in light to moderate PA ($p <$ 0.02). Although differences between groups were not tested for statistical significance, graphical depiction indicated that participants in either web condition showed an increase in frequency of light to moderate PA participation following the intervention that was not visible in the no-treatment control condition. Notably, participants in the "MyStudent Body – Stress" condition had the lowest baseline frequency of PA participation, and the highest PA participation by one month post baseline, and this trend continued through six months post baseline. These findings support the implementation of individually-tailored websites involving feedback to enhance PA participation among college students (Chiauzzi et al., 2008). In addition to needing to investigate applicability for more diverse populations, an approach which is explicitly MI-consistent was investigated.

Summary of limitations and implications of web-based interventions for physical activity promotion. At the same time that there is increasing accessibility of the Internet, there is a growing body of research to support web-based applications for PA promotion. There is support for interventions which are theoretically guided (Carr et al., 2007; Marcus, et al. 2007; Napolitao et al., 2003; Sciamanna et. al., 2002; Woolf et al., 2006), and which may take the form of MI which is adapted for web delivery (Chiauzzi et al., 2008). Because this area of research is new, there are questions that can be answered to progress our understanding of how to enhance web delivery.

Future studies should focus on applying strong research methodology to build confidence in PA outcomes, as well as applying recruitment strategies that lend to clinical applications. To further strengthen confidence in findings that web-based interventions are effective, consistent with the Carr et al. (2007) study, objective assessment of PA should be applied. In addition to the need for direct observation of PA as an outcome, current research included participants who are likely to benefit from PA enhancement by including those participants who are not meeting PA guidelines. One possible way to select for participants who would benefit from PA was by recruiting through a primary care setting, along with screening based on PA guidelines. The benefit of recruiting through a physician office setting is that, the intervention can serve as a tool which clinicians can utilize to engage insufficiently active patients.

In addition to the need to include participants who are insufficiently physically active and engage in recruitment that lends to clinical applications, there was a need to identify the specific mechanisms by which interventions have an effect. Specific to web-based MI adaptations, it was possible to assess the underlying cognitive mechanisms of

intervention effect as part of the current study. An understanding of the mechanisms by which web-based MI influences cognitions related to PA, can help to inform protocols for intervention delivery in terms of content to maximize efficiency and efficacy.

Integrated summary of Motivational Interviewing and web-based intervention findings. Until very recently, research on MI and on web-based PA promotion efforts were separate lines of inquiry. Research on MI as an intervention approach to altering behavior was initially established for face-to-face delivery in the substance use and abuse arena (Miller & Rollnick, 2002). More recently, the MI approach was extended to other health behaviors (i.e., PA) with good success when applying either face-to-face or telephone MI (Ang et al., 2007; Bennett et al., 2007; Miller & Rollnick, 2002; Scales & Miller, 2003). Around the same time that MI proliferated, a separate line of inquiry considering the possible utility of the Internet to deliver PA interventions piqued the interest of researchers and clinicians (Carr et al., 2008; Chiauzzi et al., 2008; Marcus, Lewis, Williams, Dunsiger et al., 2007; Napolitano et al., 2003; Webber et al., 2008; Williams et al., 2009). The Internet gained popularity and the increasing accessibility among the general population (Jones & Fox, 2009) led researchers to question whether web-applications for PA promotion would be effective. Inquiry considering MI for PA promotion and inquiries considering web-based interventions for PA promotion alike, are ongoing. In the very recent past, research addressing web-based MI for health behaviors including PA (Chiauzzi et al., 2008; Webber et al., 2008) has emerged. Based on collective findings pertaining to theoretically-based web interventions for PA promotion, it is necessary to investigate the

efficacy of web-based MI as a method that lends readily to practical applications for PA promotion.

Executive Summary

The problem of insufficient PA participation was addressed in the current study through investigation of web-based MI as a possible intervention. Web-based MI was investigated in the present study as a method for PA enhancement (Chiauzzi et al., 2008). Studies to date have not addressed the mediating mechanisms by which MI may influence PA participation. Therefore, a model (See Figure 1) was tested which depicts hypothesized relationships between MI, PA, and cognitive mediator variables.

CHAPTER III: Methods

Introduction

There is a clear need to continue to seek strategies to promote physical activity (PA), given the known health consequences of insufficient PA participation, ongoing prevalence of insufficient PA participation, and lack of sufficient interventions to alleviate the problem. As such, the Aims of the current study were:

1. To determine if web-based MI was effective to enhance PA participation.
2. To assess the mechanisms by which web-based MI enhanced PA through changes in targeted cognitive variables.

Participants

Recruitment. Adults ages 21-65 who engaged in insufficient PA based on Centers for Disease Control (CDC) standards, had computer access, were given medical clearance for activity, and were not pregnant, were recruited for the current study. Participants were recruited through Aurora RiverCenter clinic located in Milwaukee, Wisconsin through either (a) active recruitment by physician referral, (b) passive recruitment by study fliers placed at reception desks, or (c) active recruitment by primary investigator (PI). Given low recruitment by physicians due to limited time, most participants were recruited through the latter two methods.

The recruitment protocol involving active physician recruitment detailed that a Medical Assistant at the Aurora clinic spoke with patients prior to physician office visits, and asked patients to complete a card asking them to respond to the following statement: "Do you currently participate in 30-minutes or more of moderate intensity physical activity, things that are about as hard as a brisk walk, 5 or more days per week?" Patients

were also asked to report age, computer access, phone number, and e-mail as well. The Medical Assistant was also asked to check a box to indicate whether the patient was deemed physically able to participate in an intervention to increase PA. Based on these questions, patients who were under-active or inactive, had computer access and were cleared for PA participation, were referred for pre- screening.

Due to low recruitment through the active physician referral process, a passive recruitment process and an active recruitment process conducted by the PI instead of physicians was developed and implemented. For passive recruitment, a multi-color flier titled "Interested in Weight Loss?" which briefly detailed the incentive for participating as well as who could be involved, and expectations of those involved was created in collaboration with clinic staff (Appendix A). The flier was placed at reception desks throughout the clinic, and receptionists collected completed fliers which were retrieved by the PI weekly. The same flier was used as a visual aid during active recruitment. Active recruitment involved the PI circulating in the waiting rooms with a clipboard and fliers and approaching persons waiting for appointments. The PI verbally summarized information on the fliers and gathered contact information from interested parties.

Pre-screening was different for active recruitment by physicians versus either passive or active recruitment by fliers. For those participants referred by their physicians, pre-screening was conducted by the PI at the primary care physician's office directly following patient appointments. During pre-screening, informed consent was completed. At the in-person pre-screening meeting, eligible participants self-reported that they did not meet the CDC's current guidelines for activity. Participants who did not meet CDC guidelines for PA were asked to complete a stage of change inventory, and were given a

pedometer and instructed in how to use the device to collect the remaining pre-screening/baseline information during a 7-day recording period. Enrollment criterion indicated that to be eligible, participants must take fewer than 10,000 steps per day on average. Participants were contacted via e-mail to obtain steps per day as tracked by pedometer recordings.

For participants who were recruited through either the passive or active process involving the flier, pre-screening tasks were conducted online. Physician clearance was obtained by e-mailing the physicians of potential participants in order to inquire as to whether these patients were cleared to participate in an online program. Given physician clearance, interested patients were e-mailed a link to an online informed consent document. Upon completion of informed consent, participants were e-mailed screening surveys. Pedometers were mailed to those individuals who self-reported not meeting CDC guidelines for activities. These persons were e-mailed instructions for pedometer use as well as sheets to record daily steps. Participants e-mailed their step counts to the PI for processing. Regardless of recruitment method, participants who met screening criterion were next sent an e-mail link to complete the baseline surveys prior to intervention enrollment.

Sample characteristics. A multi-ethnic and bi- gender population was attained by recruiting through a diverse urban clinic. Twenty-three of the 237 patients recruited at the healthcare clinic who provided contact information completed all study components (see Figure 2). The predominant source of attrition was passive drop-out (n = 122) across all study phases, followed by inability to contact the patient's physician for clearance (n = 38), already meeting CDC guidelines for activity (n = 23), not having computer and/or e-

mail access (n = 9), exceeding 10,000 steps per day on average (n = 7), physician advisement against participating (n = 5), and finally declined participation (n = 5). For those patients who were retained until program enrollment (n = 31), a majority completed the program itself (n = 25, 81%). Demographic characteristics including gender, race, and body mass index (BMI) classifications for those participants who completed the program, post and post2 are provided in Table 1. Persons who were ineligible for any reason, or unwilling to participate, were referred back to their treating physician for further consultation. Participants were given a pedometer as an incentive for participating, as well as a $50 gift card to Target for completing all study components.

In summary of the participant retention and characteristics, attrition was a challenge in this study given that only 9.7% of patients expressing interest followed through with all phases of the study. Ultimately, a racially diverse sample comprised primarily of adult women (87%) participated. Participants were racially diverse in that 43.5% classified themselves as minorities. Participant BMI categorizations based on self-reported height and weights suggest that the majority of the sample (i.e., 95.6%) was either overweight or obese.

Assessment

Participants were prompted by e-mail to complete surveys (a) immediately before web-based program participation (pre), (b) directly post-intervention (post1), and (c) 3-months after intervention enrollment (post2). Self-report surveys were converted into web-based formats. Participant responses were recorded and stored in a secure database using Qualtrix survey software. In-person pre-screening data and pedometer data were entered into by the PI.

Of note, after baseline data were collected, participants were asked to refrain from wearing the pedometers. Below is a description of assessment tools that were used to assess PA and cognitive variables of interest (see Appendix B for a copy of text-based surveys that were converted to online surveys).

Physical Activity

Physical activity assessment included 7-day periods of time to allow for consideration of whether each person was meeting health objectives set forth by the CDC (CDC, 2001). Both objective and subjective measures were used as indicators of PA participation in order to triangulate results from either type of tool, particularly given that despite overall reliability of self-report measures, persons who were insufficiently physically active tend to over-report PA using self-report tools (Fogelholm et al., 2006). As an additional precaution, those participants who reported that "yes" they were meeting CDC guidelines for activity were questioned further by the PI to determine if in fact their answers at pre-screening were valid.

Objective physical activity assessment. Yamax SW-200 pedometers were used to measure steps taken per day, which were previously established as an appropriate indicator of PA, given that walking is the most common form of PA among adults (Bassett et al., 1996; Bassett & Strath, 2002). Total steps over the course of 7-days at pre-intervention and again post-intervention were recorded with the pedometer worn at the hip. Steps per day were recorded by the individual each day. Each participant was given instructions for recording and e-mailing daily steps to the PI. Pedometer data were compiled by tabulating the total number of steps recorded by the participant each day for 7-days. Average number of steps per day were tabulated.

Yamax pedometers previously have demonstrated a high degree of reliability, given estimates of 100% of steps counted accurately on a consistent basis (Bassett et al., 1996). Based on consideration of 25 studies including men and women with ages ranging from 7-82 years, pedometers also demonstrate good convergent validity when compared to accelerometer (median r = 0.86), (median r = 0.82) and standard observation of walking (*M* r = 0.82) (Tudor-Locke, Williams, Reis, & Pluto, 2002). Among middle aged men and women (*M* age = 38.9 years), pedometers demonstrate moderate construct validity when correlated with fitness-related variables including VO_2 max (median r = 0.41) (Tudor-Locke et al., 2002). Mean and standard deviations for steps per day observed in the current study are provided in Table 2.

Subjective physical activity assessment. The International Physical Activity Questionnaire (IPAQ) short form for self-administration was used to assess number of minutes spent participating in PA in the past 7-days (Craig et al., 2003). The participants were asked to report number of days per week, hours and minutes of engagement in behaviors classified as vigorous, moderate, walking, and sitting. The IPAQ has previously shown sufficient test-retest reliability among adults in the United States ranging in age from 18 to 65 years (ρ= 0.66 - 0.88), and has shown moderate criterion validity against CSA accelerometers (Craig et al., 2003). The IPAQ was used to generate weekly estimated energy expenditure expressed as MET-minutes/week (Craig et al., 2003). Total PA MET-minutes/week (TOT METs) were calculated in accordance with IPAQ scoring guidelines by summing the following: (a) 3.3 x walking minutes x walking days; (b) 4.0 x moderate-intensity activity minutes x moderate days; and (c) 8.0 x vigorous intensity activity minutes x vigorous intensity days. Author guidelines were

followed to compile total weekly vigorous (V), moderate (M), walking (W), and sitting (S) METs at each time point. Mean and standard deviations for IPAQ variables at each time point are presented in Table 2. For several IPAQ variables (i.e., total, W, and S mets) there appears to be a non-linear increase over time. It is not clear whether non-linear trends were observed strictly due to small sample size or whether something systematic is causing non-linear changes such as intervention participation.

Stage of Change

The five-item Exercise Stages of Change questionnaire developed by Marcus and Simkin (1993) was used to identify stage categorization as precontemplation, contemplation, preparation, action, or maintenance. The Exercise Stages of Change questionnaire has previously shown high test-retest reliability among adult men and women (r = 0.90) over a two week period (Marcus, Selby, Niaura & Rossi, 1993) and was significantly correlated with indexes of PA such as accelerometer readings (r = 0.32) and treadmill exercise time (r = 0.56) (Schumann et al., 2002). The Exercise Stage of Change questionnaire yields classification consistent with similar PA categorization scales, suggesting that the scale is valid for implementation to assess PA stage of change among working aged adult men and women (Marcus & Simkin, 1993).

Responses on the Exercise Stage of Change questionnaire were compiled to assess stage categorization according to guidelines set forth by Marcus and Simkin (1993). Each stage was coded as a number, where higher numbers indicated greater proximity to the action stage of change. Observed participant stage classifications at each time point are provided in Table 3.

Decisional Balance

Decisional balance related to PA participation was assessed using a 16-item questionnaire which asked participants to rate the importance of statements pertaining to making decisions about whether to exercise (Marcus, Rakowski, & Rossi, 1992). Internal consistency reliability, previously assessed among working aged adult men and women and was good for both pros ($r = 0.95$) and cons ($r = 0.79$). In addition, the scale previously demonstrated agreement with stage classification, where participants in the maintenance phase were more likely to endorse pros, consistent with expectations (Marcus, Rakowski et al., 1992). In addition, the scale demonstrated acceptable or better internal consistency reliability in the present study for pros and cons at all time points (see Table 4).

Using the decisional balance scale, ratings were compiled to assess endorsement of pros and cons of exercise consistent with instructions offered by scale developers (Marcus, Rakowski et al., 1992), where higher scores indicate greater endorsement of pros and cons for respective subscales. Mean and standard deviations observed in the current study for decisional balance pros and cons are provided in Table 5.

Processes of Change

A reduced version of the 39-item Exercise Processes of Change Questionnaire (PCQ) was administered to assess endorsement of processes of change including subscales for cognitive processes (i.e., consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, social liberation) and behavioral processes (i.e., counterconditioning, helping relationships, reinforcement management, self-liberation, and stimulus control (Marcus, Rossi, Selby, Niaura, & Abrams, 1992). Each

subscale of the PCQ previously demonstrated acceptable, or better, internal consistency (r = 0.62 - 0.89) among male and female working aged adults. In addition, the questionnaire correlated with stage of change in a direction consistent with expectations within the same population (Marcus, Rossi et al., 1992). Reductions that occurred due to administrative error included that the social liberation subscale of cognitive processes was omitted (items 16-19), as well as one item from the counterconditioning subscale of behavioral processes (item 22) and one item of the self-liberation scale (item 32) of behavioral processes. These reductions did not undermine internal consistency reliability in the current study, as is detailed in Table 4.

Scaled responses derived from the PCQ were compiled for each subscale, in accordance with instructions offered by scale developers to assess endorsement of specific processes of change (Marcus, Rossi et al., 1992). Higher scores indicated greater engagement in specific cognitive and/or behavioral processes of change. Mean and standard deviations for PCQ scores observed in the current study and subscales at each time point are provided in Table 5.

Self-efficacy

A five-item self-efficacy (SE) self-report questionnaire was used to assess SE related to PA (Marcus, Selby, Niaura, & Rossi, 1992). The SE questionnaire has previously demonstrated good internal consistency among working aged men and women (r = 0.82) and test re-test reliability (r = 0.78) (Marcus, Selby et al., 1992). Internal consistency was acceptable in the current as well (see Table 4).

Scores were compiled to assess overall SE for PA participation (Marcus, Selby et al., 1992), where higher scores were associated with greater SE. Observed means and standard deviations are provided in Table 5.

Motivation

A reduced version of the Behavioral Regulation in Exercise Questionnaire (BREQ-2) was administered to assess cognitions related to motivation for exercise. The BREQ-2 was a 19-item questionnaire that included subscales to assess amotivation, external regulation, introjected regulation, identified regulation, and intrinsic regulation (Li, 1999). In previous research, all of the subscales of the BREQ-2 showed good internal consistency among general practice referral scheme participants (i.e., amotivation $r = 0.83$, external regulation $r = 0.79$, introjected regulation $r = 0.80$, identified regulation $r = 0.73$, and intrinsic regulation $r = 0.86$). Due to administrative error, only 17 questions were included in the online version. Specific items omitted included item 19 from the amotivation subscale, and item 18 from the intrinsic regulation subscale. These omissions did not undermine internal consistency reliability in the current study, as is detailed in Table 4. By compiling the scaled responses on the BREQ – 2, the relative autonomy index (RAI) was computed (Li, 1999) as an index of internalized motivation for PA, where higher RAIs indicate greater internalization of PA motivation. In addition scores for each subscale of the BREQ – 2 were computed by summing scores for pertinent items. Observed means and standard deviations for BREQ-2 subscales are provided in Table 5.

Enjoyment

Self-reported enjoyment of PA as assessed by the PACES were compiled in order to create a score that reflected overall enjoyment (Kendzierski & DeCarlo, 1991), where a lower score was associated with greater PA enjoyment. The 18-item scale asked participants to rate feelings related to PA (Kendzierski & DeCarlo, 1991). The PACES scale was developed among a sample of adults, ages 21 – 52, and previously demonstrated good test-retest reliability ($r = 0.83$) and good internal consistency ($r = 0.79$) within the specified population (Kendzierski & DeCarlo, 1991). Internal consistency was also acceptable in the current study (see Table 4). Mean and standard deviations for PACES scores are also provided in Table 5.

Intention

A single item question pertaining to intention to engage in PA was included. The statement was similar to suggested intention assessment related to weight loss, offered by Ajzen and Fishbein (1980). A single item score for intention to engage in PA was reported (Ajzen & Fishbein, 1980), where a lower score indicated greater intention to engage in PA. Given that this is a single item, psychometric properties were not previously established. Observed means and standard deviations for intentions are reported in Table 5.

Willing, Ready, and Able Constructs

In preparation for model testing, composite scores for cognitive constructs including *willingness* (i.e., intention, decisional balance, and intrinsic motivation/enjoyment), *readiness* (i.e., readiness to change, processes of change), and *ability* (i.e., SE) were created by tabulating change scores from pre to post1. Reliability

coefficients for the *willingness* ($\propto = 0.663$) and *readiness* ($\propto = 0.559$**)** constructs were somewhat low, and the coefficient for *ability* was not generated due to inclusion of only SE scores.

Procedures

Eligible participants were sent an e-mail with a link to participate in a web-based program. Over the course of 4-weeks, participants engaged in four self-guided web-based sessions which required participant responses. Each session was expected to take approximately 15 minutes per week to complete, for a total of 60 minutes.

The web-based sessions reflected principles and techniques consistent with MI. These sessions involved prompting the participant to engage in self-reflection and goal setting by offering questions to which the participant responded. The first session included introductions, building rapport, creating a discrepancy between current PA and goals, and exploring barriers to PA. After the first session, participants were e-mailed a message thanking them for participating and reflecting their responses. The second session involved feedback regarding PA, eliciting *change talk* regarding PA, and offering a menu of PA options. During the third treatment session, participants developed a change plan, and the commitment to change was strengthened. During the fourth and final session, efforts to change were affirmed and commitment was further reinforced. Collectively, the sessions were geared at enhancing *readiness*, *willingness*, and *ability* to engage in PA, consistent with the vision of developers Miller and Rollnick (2002). The text-based outline of the MI is provided (See Appendix C).

CHAPTER IV: Results

Introduction

Testing of four research hypotheses was conducted in the current study in order to address the following Aims:

1. To determine if web-based MI was effective to enhance PA participation.
2. To assess the mechanisms by which web-based MI enhanced PA through changes in targeted cognitive variables.

To address these broad objectives, an overview of hypothesis testing procedures is provided, followed by results of specific statistical analyses pertinent to research hypotheses. Finally, results of hypothesis testing are summarized.

Statistical Analyses

Aim #1

Hypothesis #1 testing. Consistent with Aim #1, Hypothesis #1 was that web-based MI would increase PA. In order to assess the effect of the intervention on PA, the normality of the distribution of test steps per day was first evaluated to ensure appropriateness of parametric testing. Distributions were normal, and no transformations were needed. Therefore, a paired samples t-test was conducted to compare average steps per day from pre-intervention to post-intervention.

Subjective reports of PA participation including CDC guideline compliance and IPAQ scores were used to corroborate objective (i.e., steps) findings. A McNemar test was conducted to assess changes in compliance with CDC guidelines. For IPAQ variables distributions were positively skewed. Therefore, Friedman's nonparametric test

with post hoc Wilcoxon follow-up analyses were conducted to assess differences in IPAQ variables over time.

Hypothesis #1 results. Participants demonstrated a significant increase in average steps per day from pre to post1 (t[22] = 2.085, p =0.049) (See Table 2). Consistent with objective findings, whereas none of the participants were meeting CDC guidelines at pre, 45.83% reported that they were meeting CDC guidelines at post1 and 52.17% at post2, which represented a significant increase in adherence to CDC guidelines from pre to post1 (p = 0.004), and from pre to post2 (p = 0.002).

To further investigate the finding that web-based MI increased PA, Friendman's statistics were used to assess changes in weekly energy expendature followed by Wilcoxon follow-up tests when significant changes were observed. Participants reported significant increases in weekly total energy expenditure (i.e. TOTMETs) over time based on Friedman's test results (χ^2 = 8.430, p = 0.015). In addition, participants reported significant increases in moderate intensity PA energy expenditure (i.e., MMETs) over time (χ^2 = 13.853, p = 0.001). Regarding TOTMETs, changes were not significant based on Wilcoxon follow-up tests from pre to post1 (z = 1.721, p = 0.085), pre to post2 (z = -1.568, p = 0.117), or post1 to post2 (z = .852, p = 0.394). Follow-up testing revealed that there were significant differences in MMETS from pre to post1 (z = 2.729, p = 0.006), and from pre to post 2 (z = 2.845, p =0.004), but not from post1 to post2 (z = .523, p = 0.601). While participants reported increases in total and moderate intensity activity, there were not significant increases in weekly vigorous activity energy expenditure (i.e., VMETs; χ^2 = 0.491, p = 0.782), or walking activity energy expenditure (WMETs; χ^2 = 0.925, p = 0.630). There also were not significant self-reported decreases

in time sitting (i.e., SME0Ts) over time ($\chi^2 = 4.576$, $p = 0.101$). Findings of the IPAQ collectively suggest that the participants may have self-selected to increase moderate intensity activity, while not changing vigorous activity, walking, or sitting behaviors.

Aim #2

Hypothesis # 2 testing. Hypothesis #2 specifically stated that MI would lead to stage progression in the direction of increased readiness to participate in PA. This hypothesis corroborates Aim #1 due to association of stage of change with PA behavior, and addresses Aim #2 due to the association between stage of change and cognitions. That is, pertinent to Aim #1, stage progression would indicate greater likelihood of PA participation. Pertinent to Aim #2, stage progression would indicate that web-based MI influenced targeted cognitions associated with PA.

To test this hypothesis, Friedman's test was conducted to test for stage progression over time, and Wilcoxon signed rank follow-up testing was conducted to compare differences at specific time-points. Also, cross-tabulation of stage classification was generated.

Hypothesis #2 results. Consistent with expectations, there was a significant increase in stage classification progression over time ($\chi^2 = 21.500$, $p < 0.001$). Mean ranks increased from pre (1.39) to post (2.23), and post2 (2.39). Follow-up testing revealed significant changes from pre to post1 ($z = 3.024$, $p = 0.002$) and pre to post2 ($z = 3.372$, $p = 0.001$) but not post1 to post2 ($z = 0.791$, $p = 0.429$). Cross-tabulation (see Table 4) further revealed that while most participants (68.06%) were in lower stages of change including contemplation or preparation at pre, by post1 the majority of participants (70.84%) were in more advanced stages of change including action and

maintenance. A higher proportion (68.18%) of participants remained in the action and maintenance at post2. Notably, none of the participants reported being in the precontemplation stage of change at any time point, suggesting that individuals who were not considering change were not successfully recruited for the study, and intervention findings can not be generalized to individuals in the precontemplation stage of change.

Hypothesis #3 testing. The third hypothesis, which addresses Aim #2, suggested that web-based MI would influence theoretically identified cognitive variables. To test the influence of MI on cognitive variables, first normality of each distribution was considered to determine appropriateness of parametric testing. Then, a series of repeated measures ANOVAs were conducted to test for change over time in: (a) decisional balance to PA, (b) processes of change, (c) SE, (d) motivation, and (e) enjoyment. When significant change was found over time, follow-up analysis involving simple contrasts to test for differences between pre and post1 as well as pre and post2 were conducted. To test changes over time in single-item representation of intention, a series of Wilcoxon signed rank contrasts were performed.

Hypotheses #3 results. Findings partially supported change in targeted cognitive variables following participation in MI. Means and standard deviations for decisional balance, processes of change, SE, motivation, enjoyment, and pertinent subscales are reported in Table 5. A summary of repeated measures ANOVA testing is provided in Table 6. For several variables, there was an observed violation of the sphericity assumption and, therefore, the Wilks' Lambda was reported where indicated as a multivariate statistic that is not affected by sphericity violations. Consistent with expectations, there were significant changes over time in: (a) decisional balance pros and

cons; (b) behavioral processes of change including subscales for counterconditioning, reinforcement management, self-liberation, and stimulus control; (c) BREQ-2 subscale for intrinsic regulation; (d) PA enjoyment; and (e) SE. Contrary to predictions, there were not significant differences over time in: (a) cognitive processes of change or related subscales; (b) the helping relationships subscale of the behavioral regulation processes of change; or (c) BREQ2 subscales including amotivation, (d) introjected regulation, identified regulation, or relative autonomy index (RAI) scores. Additionally, non-parametric testing indicated that there was not a significant increase in self-reported intention to engage in PA from pre to post1 (z = -0.171, p = 0.865), pre to post2 (z = -1.027, p = 0.305, z = -0.061, p = 0.952).

Simple post hoc tests indicated that for all cognitive variables for which significant differences were observed over time other than SE and the stimulus control subscale of the IPAQ, the differences were significant from pre to post1, and were sustained until post2 given significant pre to post2 contrasts. Specifically, there were significant differences in: (a) decisional balance pros from pre to post1 (F [1.21] = 18.504, p < 0.001) and pre to post2 (F [1,21] = 21.927, p =0.002), (b) decisional balance cons from pre to post1 (F[1,21] = 7.840, p < 0.001) and pre to post2 F[1,21] = 12.012, p = 0.002), (c) behavioral processes of change from pre to post1 (F[1,21] = 10.227, p =0.004) and pre to post2 (F[1,21] = 14.556, p = 0.001), (d) counterconditioning from pre to post1(F (1,210 = 18.857, p = 0.001) and pre to post2 (F[1,21] = 15.903, p = 0.001),(e) reinforcement management from pre to post1 (F[1,21] = 15.903, p = 0.005) and pre to post2 (F[1,21] = 12.405, p = 0.002), (f) self-liberation from pre to post1 (F[1,21] = 12.669, p = 0.002) and pre to post2 (F[1,21] = 14.929, p = 0.001),

(g) BREQ2 subscale for intrinsic regulation from pre to post1 ($F[1,19] = 23.058$, $p = 0.000$) and pre to post2 ($F[1,19] = 18.883$, $p < 0.001$), and (h) PA enjoyment from pre to post1 ($F[1,21] = 7.840$, $p = 0.011$) and pre to post2 ($F[1,21] = 5.689$, $p = 0.027$). For SE, although the differences were not significant from pre to post1($F[1,21] = 0.500$, $p = 0.487$), there were significant increases SE from pre to post2 ($F[1,21] = 5.158$, $p = 0.034$) . Likewise for stimulus control, differences were not significant from pre to post1 ($F[1,21] = 1.337$, $p = 0.261$), however difference were significant form pre to post2 ($F[1,21] = 6.205$, $p = 0.021$).

Hypothesis #4 testing. The fourth hypothesis, which also addresses Aim #2, was that changes in cognitive variables would influence increases in PA participation from pre-intervention to post-intervention. A partial least squares (PLS) modeling approach (Haenlein & Kaplan, 2004; Wold, 1975) was conducted using *WarpPLS 3.0* software. Path coefficients were attained for direct and indirect effects of changes in cognitive constructs (i.e., *willing, ready,* and *able)* on changes in PA (i.e., changes in average steps per day from pre-intervention to post-intervention) (See Figure 3).

Hypothesis #4 results. Possibly due to small sample and low reliability despite significant findings pertinent to change in cognitive variables after MI participation, PLS modeling did not support an effect of changes in cognitive constructs and PA participation in that direct and indirect effects between cognitive variables and PA were not significant (see Figure 3). Despite that individual path coefficients were not significant, model fit testing indicated significant average path coefficient ($\beta = 0.309$, $p = 0.006$), good average variance inflation factor (1.235), but non-significant average R^2 (0.311 $p = 1.081$) within the model.

Summary

Participants included in analyses were a racially diverse cohort of underactive or inactive adults who were predominantly overweight or obese women. Pertinent to Aim #1, results of the current study indicate increases in steps per day, CDC activity guideline compliance, TOT METs, and MMETs of weekly activity following participation in web-based MI. Pertinent to Aim #s 1 and 2 and consistent with PA findings, after program participation there was evidence of stage progression indicative of greater participation in PA. Pertinent to Aim #2, with regard to change in targeted cognitive variables following intervention participation, there was evidence of change in some of the cognitive variables associated with: (a) *willingness* to participate in PA (i.e., intrinsic regulation and PA enjoyment), (b) *readiness* to participate in PA (i.e., stage of change and behavioral processes of change), and (c) perceived *ability* to participate in PA (i.e., SE). Findings pertinent to *willingness, readiness,* and *ability* suggest that MI was effectively conducted in that targeted cognitions were altered.

Self-report findings at post2 collectively indicate that increases in PA, stage progression, and changes in targeted cognitive variables were sustained at follow-up which occurred 3-months post intervention initiation. Despite findings that PA increased and several targeted cognitions were altered in the hypothesized direction following MI intervention, PLS modeling did was inconclusive regarding direct or indirect effects of changes in cognitions on PA participation due to sample size limitations. Further interpretation of both significant and non-significant findings is necessary to inform both future research and intervention application efforts.

CHAPTER V: Discussion

Introduction

Increasing physical activity (PA) is a public health priority given that most adults in the United States are underactive or inactive (CDC, 2007; DHHS, 2000). Motivational Interviewing (MI) is one approach to increasing PA that has previously received preliminary support when delivered in either face-to-face, telephone, or face-to-face plus telephone formats (Ang, Kesavalu, Lydon, & Bigatti, 2007; 2007; Bennett, Lyons, Winters-Stone, Nail, & Scherer, 2007; Miller & Rollnick, 2002; Scales & Miller, 2003). Recently, web-based delivery of PA interventions has been popularized due to increased Internet use (Fox, 2009). There is a growing body of support for using web-based interventions to increase PA (Carr et al., 2008; Chiauzzi, Brevard, Thum, Decembrele & Lord, 2008; Marcus, Lewis, Williams, Dunsiger et al., 2007; Napolitano et al., 2003; Webber, Tate & Quintiliani, 2008**;** Woolf et al., 2006). While there is support for MI to enhance PA and web interventions are becoming more popular, there is limited research into whether web-based MI can be applied to successfully alter health behaviors including PA (Chiauzzi et al., 2008; Webber et al., 2008).

In addition to the limited number of research studies investigating whether web-based MI can increase PA, studies of web-based interventions for PA are more generally limited in that they typically have not: (a) used objective PA assessment, nor (b) considered the mechanisms by which MI theoretically causes change in PA. Lack of objective PA assessment is a methodological limitation of all but one efficacy study of web-based interventions (Carr et al., 2008). Findings of studies relying solely on subjective self-report data (Marcus, Lewis, Williams, Dunsiger et al., 2007; Napolitano et

al., 2003; Webber et al., 2008) need to be corroborated with objective PA data to enhance confidence in findings (Bassett & Strath, 2002). In addition to general lack of objective data, there are just two studies that investigated web-based MI as a specific intervention strategy, and neither has assessed the cognitive mechanisms of MI. That is, cognitive variables that are targeted during MI are not assessed as potential mechanisms of change in PA. An understanding of the mechanisms by which MI influences PA participation is necessary to guide intervention content and delivery.

In order to address the aforementioned research limitations, and to inform practical application of MI intervention delivery, the Aims of the current study were:

1. To determine if web-based MI was effective in enhancing PA participation.
2. To assess the mechanisms by which web-based MI enhanced PA through changes in targeted cognitive variables.

Relevant to Aim #1, results of the current study indicated increases in PA following participation in a web-based MI intervention. Relevant to Aim #2, results of the current study indicated changes in targeted cognitive variables following participation in a web-based MI intervention. In this chapter, findings pertinent to Aim #1, Aim #2, and related hypotheses are discussed and compared to previous research. The four specific research hypotheses of the study discussed were:

Hypothesis 1: Web-based MI will lead to increased PA;

Hypothesis 2: Web-based MI will lead to stage progression in the direction of increased readiness to participate in PA;

Hypothesis 3: Web-based MI will have a direct effect on targeted cognitive variables;

Hypothesis 4: Changes in targeted cognitive variables will have an indirect effect on PA participation.

Findings regarding research hypotheses have relevance to clinical applications given that the study was conducted in a physician office setting. Therefore, following a summary of findings pertinent to each hypothesis, implications for applying web-based MI in a clinical setting is discussed. In addition to discussion of clinically relevant implications of current findings, suggestions for future research efforts are provided.

Aim #1

Hypothesis #1

In order to assess whether PA increased following participation in a web-based MI intervention, PA was assessed both objectively using 7-day pedometer recordings gathered before the intervention (pre) and immediately after the intervention (post1). In addition, PA was subjectively assessed using self-report tools at pre, post1, and 3-months post intervention initiation (post2). Participants reported: (a) whether they were meeting the CDC (2007) guidelines for PA, and (b) energy expenditure (METs) of vigorous, moderate, walking and sitting activity accrued in a week using the short version of the International Physical Activity Questionnaire (IPAQ). Objective and subjective PA assessment data were used to determine whether participants engaged in more PA following participation in the MI intervention.

Objective physical activity. Consistent with expectations, participants in the current study demonstrated significant increases in average steps per day comparing steps counts at pre to post1. These findings are consistent with those of Carr et al. (2008) who also showed significant increases in steps per day following participation in a cognitive

behavioral web-based intervention. Although Carr et al. (2008) did not corroborate objective findings with self-report PA data in order to strengthen conclusions, results of the Carr et al. (2008) study are in agreement with current findings.

Subjective physical activity. Consistent with expectations, in the current study objective PA assessment findings were supported by self-reported data. That is, while none of the participants were meeting the CDC (2007) activity guidelines prior to participation in the intervention approximately half of the participants were meeting guidelines after participation in the intervention. Additionally, in the current study participants demonstrated increases over time in total METs of PA and moderate METS of PA. These findings are generally in agreement with self-report findings from two prior cognitive behavioral web-based interventions which showed increases in total minutes of PA (Marcus, Lewis, Williams, Dunsiger, et al. 2007), a trend toward increases in moderate intensity activity (Woolf et al., 2006), and a significant increase in walking (Napolitano et al., 2003). In addition, there was consistency in the findings of the current study and two web-based MI intervention studies that showed increases in PA that were directly (Webber et. al., 2008) or indirectly assessed (Chiauzzi et al., 2008). Agreement between results of the current study and previous studies of cognitive behavioral web-based interventions support the notion that interventions that target cognitive variables are beneficial to increase PA. Additionally, consistent findings between the results of the current study and previous studies of web-based MI interventions support that web-based MI may increase PA behavior.

Despite similar findings, differences between past research and current research in subjective assessment of PA, population selection, and intervention delivery preclude

direct comparison of results. That is, not all studies allow comparison of results in terms of intensity of PA that participants selected due to differences in assessment methods. Further, due to differences in the population included, participants may have self-selected different intensities of PA which further inhibits the ability to compare what intensity of PA such interventions are likely to influence. Finally, intervention delivery method and content are not consistent across studies, and those interventions that do involve web-based MI do not exclusively target PA as in the current study.

Summary of objective and subjective physical activity findings. In summary, increased PA was expected given that researchers (Carr et al., 2008; Chiauzzi et al., 2008; Marcus, Lewis, Williams, Dunsiger et al., 2007; Napolitano et al., 2003; Webber et al., 2008; Williams et al., 2009) have previously shown increased PA through web-based interventions. Further, results of the current study are in agreement with the results of two web-based adaptations of MI which were previously shown to be effective in facilitating PA as part of stress management (Chiauzzi et al., 2008) and weight management (Webber et al., 2008) interventions.

Findings of the current study are novel due to PA assessment methodology, as well as intervention type. That is, the current study was the first to show increases in PA corroborated through objective and self-report data. Also, the current study was the first to test the impact of MI on PA as delivered in a web-based format. Building on past research the current study supported that PA participation among adults increased following participation in a web-based MI intervention.

Aim #2

Hypothesis #2

In order to address whether stage progression reflecting increased *readiness* to engage in PA occurred following participation in a web-based MI intervention, stage of change was self-reported at pre, post1 and post2. Participants were then classified as being in precontemplation, contemplation, preparation, action, or maintenance stages of change. A stage classification of either action or maintenance would indicate that the individual was cognitively *ready* to engage in PA.

Consistent with expectations, a higher proportion of participations were classified as being in action or maintenance at post1 compared to intake. A higher proportion of participants remained classified as in the action or maintenance stages of change at post2 compared to pre, suggesting that increased *readiness* was sustained at the follow-up. Results of the current study are in agreement with past study results of Jackson, Asimokopoulou, & Scammell (2007) which showed increases in the proportion of individuals classified in later stages of change following a face-to-face transtheoretical model (TTM) based intervention. Agreement of results in the current study and past findings support the notion that cognitive-behavioral interventions can enhance stage progression. Current findings more specifically suggest that implementation of TTM principles as part of an intervention that was more specifically MI-based is effective to facilitate increased *readiness* to engage in PA.

Hypothesis #3

In order to address whether web-based MI influenced cognitive variables (i.e., decisional balance to PA, processes of change, intrinsic motivation/enjoyment for PA,

intention), change in self-report of each variable was assessed over time. Data on cognitive variables at pre, post1, and post2 were compared to assess changes following participation in the MI intervention.

Decisional balance. Consistent with expectations, participants endorsed more pros and fewer cons associated with PA following participation in the web-based MI intervention. Increased endorsement of pros and decreased endorsement of cons was sustained until post2, suggesting that changes were sustained at follow-up. Current findings are consistent with Marcus, Owen, Forsyth, Cavill, and Fridinger's (1998) findings that participants endorsed more pros associated with PA following participation in a TTM-based intervention. Although Marcus et al. (1998) predicted that participants would endorse fewer cons over time, their predictions were not upheld. Taken together, findings of Marcus et al. (1998) and the current study collectively suggest that whereas the TTM-based intervention was effective to increase endorsement of exercise pros, following participation in the MI-based intervention increased endorsement of pros and reduced endorsement of cons associated with PA were both observed.

Processes of change. Consistent with expectations, participants in the current study reported significant increases in behavioral processes of change from pre to post1, with changes sustained until post2. In agreement with current findings, Marcus et al. (1998) also showed significant changes in behavioral processes of change following participation in a TTM-based intervention. Whereas the current study also identified changes in behavioral subscales (i.e., counterconditioning, reinforcement management, self-liberation, stimulus control) that are consistent with expectations, Marcus et al. (1998) did not report findings on specific behavioral or cognitive processes of change

subscales and therefore comparison of results is not possible. Although both the current study and Marcus et al. (1998) observed changes in behavioral processes, only the Marcus et al. (1998) study which included a 6-month rather than a 3-month follow-up showed significant changes in cognitive processes of change over time.

Despite agreement in findings pertinent to behavioral processes of change, it is unclear why changes in cognitive processes were not seen in the current study. One possibility is that behavior change occurred prior to change in cognitions. Factors that may have contributed to differences in findings are that the Marcus et al. (1998) study included a TTM-based intervention, a much larger sample, and post-tests were conducted through 6 months post intervention. Regardless of lack of changes in cognitive processes of change, it is clear that like the TTM-based intervention, increased behavioral processes of change were observed following participation in a web-based MI intervention.

Self-efficacy. Consistent with expectations, participants in the current study reported increases in self-efficacy (SE) over time. Observed increases occurred gradually given that differences in SE compared to pre did not reach significance until post2. Findings are consistent with past findings that SE increased following either TTM-based (Dishman et al., 2005; Marcus et al., 1998) or MI interventions (Bennett, Lyons, Winters-Stone, Nail, & Scherer, 2007). The findings of the current study also show increases in SE for PA following web-based MI intervention.

Motivation. Consistent with expectations, participants in the current study reported increases in intrinsic regulation following participation in the web-based MI intervention. These changes were sustained through post2, suggesting an increase in exercise motivation over time. Despite that past research has targeted motivation for PA

as part of interventions informed by self-determination theory (SDT), these studies have not directly measured exercise motivation (Dishman et al., 2005). Therefore, findings of the current study are novel in confirming that after participating in an MI intervention intrinsic regulation for PA increased. Notably, although intrinsic regulation increased over time, other variables associated with motivation including amotivation, external regulation, introjected regulation, identified regulation, and the overall relative autonomy index (RAI) were not observed. Findings of the current study collectively suggest that there were increases in intrinsic regulation but not other features of motivation following participation in a web-based MI program.

Enjoyment. Consistent with expectations, exercise enjoyment increased following MI intervention participation. Changes in enjoyment were sustained through post2. Current findings are consistent with the findings of Dishman et al. (2005) which indicated increased enjoyment following participation in a SDT-based PA intervention. The Dishman et al. (2005) study supports that PA related enjoyment can be increased through a face-to-face SDT-based intervention, whereas the current study supports that PA related enjoyment can be increased through a web-based MI intervention. Taken together, findings of Dishman et al. (2005) and the current study collectively suggest that increases in PA enjoyment are observed following either SDT-based or MI-specific interventions.

Intention. Contrary to expectations, intention to participate in PA did not significantly increase in the current study. Since past research has only considered the indirect impact of PA-related interventions on intention, there is no comparison available for current findings. It is unclear why although PA increased significantly, intention to

engage in PA did not increase significantly in the current study. It is possible that the single item inventory used to measure intention was not highly sensitive to detecting changes in intention, and therefore significance was not achieved despite a trend toward increasing intention to engage in PA.

Summary of cognitive variables findings. Findings of the current study are consistent with expectations that targeted cognitive variables would change following participation in web-based MI, and are generally consistent with past research. The theoretical underpinnings of MI indicate that cognitive variables targeted in application of the MI approach map onto constructs of *willingness* (i.e., decisional balance pros and cons, enjoyment, motivation, intention), *readiness (*i.e., stage of change and processes of change), and perceived *ability* (i.e. SE) to engage in PA (Miller & Rollnick, 2002). Overall, findings of the current study indicated that *willingness, ability,* and *readiness* constructs changed following participation in web-based MI.

Hypothesis #4

To assess whether changes in cognitive variables mediated changes in PA, model testing was conducted. Model testing was used to determine whether changes in *willing, ready,* and *ability* constructs mediated changes in steps per day observed at post1. Due to sample size limitations, tests for mediation of PA by changes in cognitive variables associated with *willingness, readiness,* and *ability* to engage in PA were not conclusive. Despite these findings, Dishman et al. (2005) found that both SE and enjoyment mediated PA participation following intervention delivery. Differences in findings of Dishman et al. (2005) are due to sample size, and may also be due to sample characteristics, or intervention features. That is, the Dishman et al. (2005) study had a much larger sample

comprised of adolescent girls in a school-based activity program, whereas the current study included fewer adults from the general population. With regard to intervention differences, Dishman et al. (2005) did not apply a web-based MI intervention. Due to key differences in sample and intervention, it is not possible to directly compare results of the current study with those of Dishman et al. (2005). Other than the Dishman et al. (2005) study, there are no other studies including tests of mediation by cognitive variables available for comparison. Due to inconclusive results of the current study as well as lack of additional results for comparison, it remains unclear whether cognitive variables mediate changes in PA following an MI intervention.

Summary of Aim #1 and Aim #2 Findings

Findings of the current study pertinent to Aim #1 and Aim #2 were generally consistent with expectations. Consistent with Aim #1, findings of the current study support that increased PA was observed following participation in web-based MI. Consistent with Aim #2, findings of the current study support the expectation that cognitive variables changed following participation in web-based MI. Findings of the current study were inconclusive with regard to the contention that changes in targeted cognitive variables would mediate changes in PA.

Conclusion

Strengths and limitations of the current study need to be taken into account when considering both scholarly and clinical implications of findings. After reviewing study strengths and limitations, implications for future research as well as clinical applications are discussed.

Study Strengths

Results of the current study contribute to the PA intervention literature by way of the unique methodology and intervention applied, as well as the population of interest. In terms of methodological strengths, the current study utilized both objective and subjective PA assessment tools in order to build strength in conclusions. Further, the study included assessment of cognitive mediator variables which are often overlooked. In terms of the intervention type applied, the current study tested web-based MI for PA promotion. This type of intervention had not previously been researched extensively and therefore contributions to this body of literature can inform additional research efforts. With regard to the population included, a racially diverse sample of underactive or inactive adults who were likely to benefit from increasing PA participation was successfully recruited. The diversity of the sample enhances the ability to generalize findings to a diverse population.

Study Limitations

Despite the strengths identified, the current study has several methodological limitations. Most notably, the current study included a small sample, which undermined the ability to test the impact of cognitive mediator variables. Therefore, it is not possible to discern whether observed lack of change in specific cognitive mediator variables (i.e., cognitive processes of change, features of motivation other than intrinsic regulation, intention) as well as lack of mediation by cognitive variables was a valid observation or was strictly due to small sample size. Further, having a small sample precluded the inclusion of a control group. Without a control group, it is not possible to discern

whether changes that occurred in PA or targeted cognitive variables occurred due to the MI intervention or due to some other factor.

In terms of interpreting outcomes, limitations of assessment using pedometers also needs to be considered. That is, pedometers may be less valid when used among persons with a body mass index (BMI) of 30 or greater. Therefore, in the current study the pedometer ratings should be interpreted with caution given that the BMI of participations was typically higher than 30. Because pedometer outcomes are consistent with self-reported PA outcomes in the current study, it seems likely that PA did increase regardless of any limitations of pedometer recordings.

Implications for Future Research

Additional research is needed to corroborate findings of the current study which suggest an increase in PA as well as changes in targeted cognitive variables following a web-based MI intervention. Future research should address limitations of the current study pertinent to sample recruitment and meditational analyses. Specifically, future research including a larger sample and a control group should be conducted to strengthen conclusions that web-based MI is effective to increase PA participation. Due to low enrollment in the current study, in order to obtain a larger sample, additional research may be necessary in order to test the feasibility and effectiveness of specific recruitment protocols in healthcare settings. Recruitment efforts that facilitate enrollment of more men, normal weight individuals, and individuals who are in the precontemplation stage of change could also enhance generalizability of findings.

Due to the limited number of individuals successfully enrolled in the study, and in an effort to maximize enrollment, the recruitment and enrollment time span for the study

was conducted for a prolonged period of time. During the prolonged study enrollment period, guidelines for PA participation among adults were modified and additional intervention research was concurrently published. Future research should address whether interventions are successful to facilitate compliance with the updated PA guidelines (i.e. adults should participate in either two and one half hours a week of moderate intensity aerobic physical activity or one hour and 15 minutes of vigorous physical activity per week, and should incorporate strength training for added health benefits) (DHHS, 2008). These updated PA guidelines may allow greater flexibility for activity selection which may contribute to greater success with meeting the guidelines. In addition to updated PA guidelines, research into MI applications for PA promotion has occurred concordantly with the current study and may further guide and inform future research (Drevehorn, Bengtson, Nillson, Nyberg & Kjellgren , 2012; Hardcastle, Black & Hagger, 2011; Quirk, Dickinson, Baune, Leicht & Golledge, 2012; Rocha-Goldberg Mdel et al., 2010; Sjoling, Lundberg, Englund, Westman & Jong, 2011; Swenson, Nissen & Henly, 2010; van Keulen et al., 2011). Notably, none of the forthcoming research has implemented MI to increase PA in a web-based format and hence the need for research of web-delivery is persistent.

Clinical Implications

Current research findings provide preliminary support for the application of web-based MI to increase PA and to alter targeted cognitive variables, subject to further research. Further efforts at disseminating web-based MI for clinical application may be supported by the current study. In order to enhance web-based MI application in health-care settings, logistical considerations pertinent to application may be beneficial. The

cost-effectiveness of implementing web-based MI may be beneficial. Also, additional consideration of how to enhance enrollment may be of benefit in terms of reaching more patients.

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Figure 1. Proposed Model of Cognitive Variables Mediating the Effect of Motivational Interviewing on Physical Activity Participation

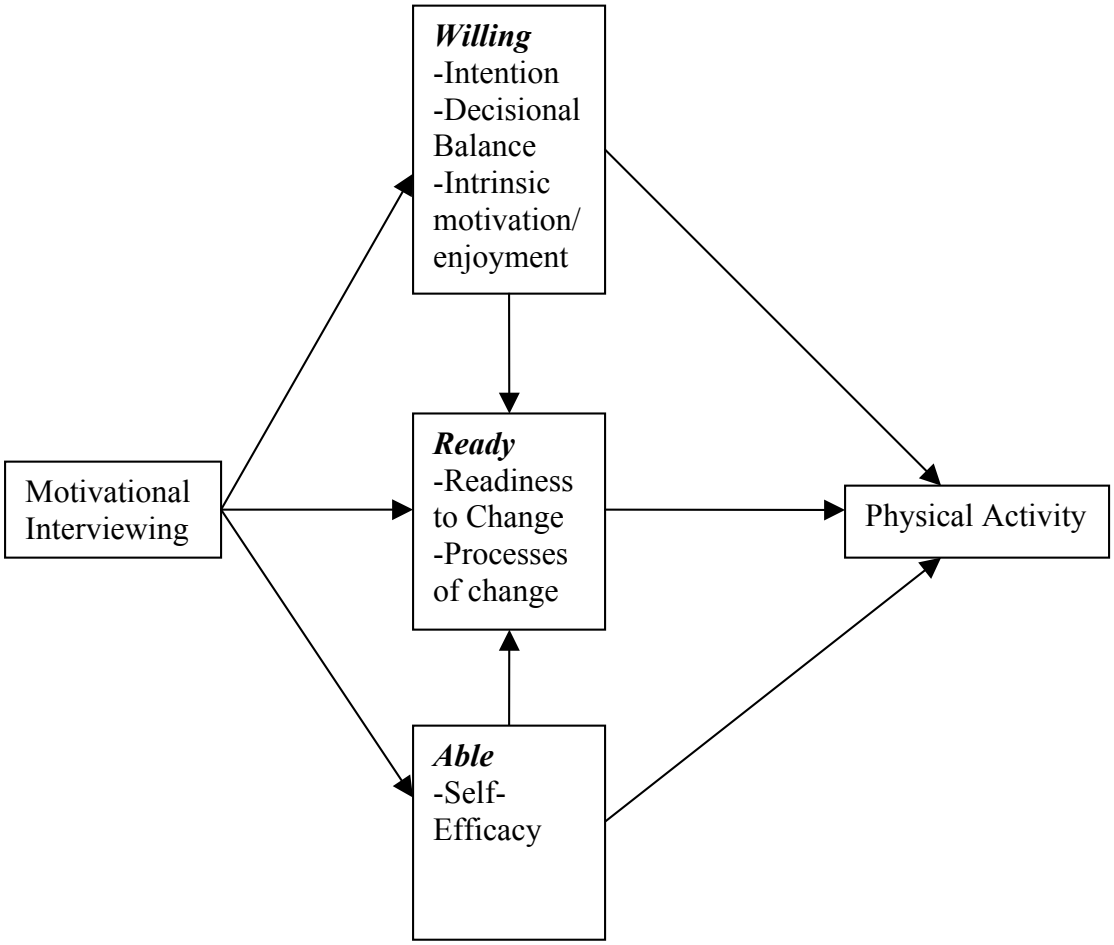

Figure 2. Recruitment, Enrollment, and Retention

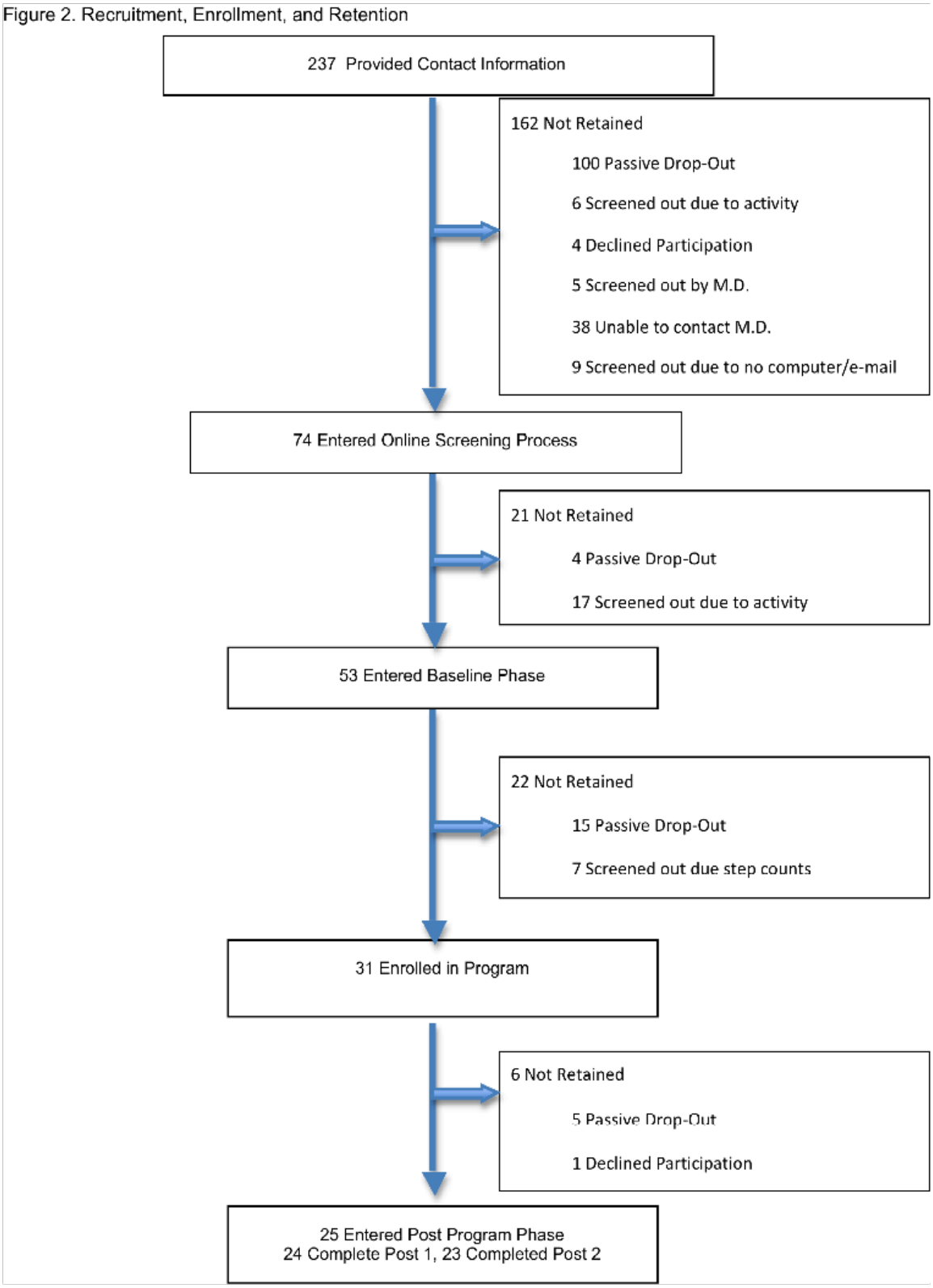

Figure 3. Direct and Indirect Effects of Change in Willing, Ready, and Able on Change in Steps Per Day

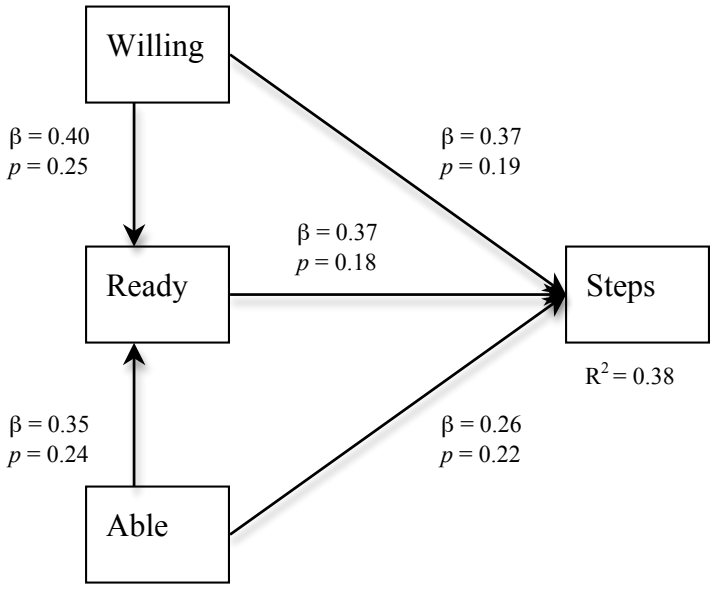

Table 1. Participant Demographic Characteristics

Measure	N	%
Gender		
Men	2	8.7 %
Women	20	87.0 %
Not Reported	1	4.3 %
Ethnicity		
White	12	52.2 %
Non-Hispanic White	2	8.7 %
African American	4	17.4 %
Hispanic	2	8.7 %
Asian, Pacific Islander	2	8.7 %
Not Reported	1	4.3 %
BMI Category		
Underweight	0	0 %
Normal	1	4.3 %
Overweight	11	47.8 %
Obese	11	47.8%
Not Reported	0	0 %

Table 2. Means and Standard Deviations for IPAQ Variables Presented as *M*(*SD)*at Each Time Point

Physical Activity Variable	Pre	Post1	Post2	N
Average Steps	5252.99 (580.45)	6425.05 (503.08)	n/a	23
TOT METs	1918.33 (2755.11)	1910.68 (2308.17)	3457.12 (5670.63)	21
VMETs	520.95 (913.73)	784.76 (1118.53)	794.29 (1570.34)	21
WMETs	1186.42 (2457.02)	632.11 (3319.91)	1589.50 (3319.91)	21
MMETs	218.00 (417.15)	518.5 (684.34)	1091.00 (2589.88)	20
SMETs	701.05 (1087.12)	435.79 (197.58)	560.52 (587.97)	21

Table 3. Percentage of Stage Classification at all Time Points

Stage Classification	Pre[1]	Post1[1]	Post2[2]
Precontemplation	0.00%	0.00%	0.00%
Contemplation	62.50%	29.17%	22.72%
Preparation	12.50%	0.00%	9.10%
Action	20.83%	54.17%	36.36%
Maintenance	4.17%	16.67%	31.82%

[1]N= 24
[2]N = 22

Table 4. Internal Consistency Coefficients for Scales and Subscales at Each Time Point

Scale	∝ Pre	∝ Post1	∝ Post2
Decisional Balance			
Pros	0.621	0.929	0.944
Cons	0.719	0.813	0.758
PCQ			
Cognitive	0.863	0.864	0.919
Consciousness Raising	0.805	0.822	0.919
Dramatic Relief	0.888	0.822	0.803
Environmental Re-evaluation	0.802	0.777	0.821
Self Re-evaluation	0.879	0.838	0.772
Behavioral	0.907	0.890	0.816
Counterconditioning	0.783	0.855	0.742
Helping Relationships	0.855	0.853	0.865
Reinforcement Management	0.779	0.806	0.712
Self-Liberation	0.610	0.808	0.703
Stimulus Control	0.704	0.761	0.784
SE	0.740	0.812	0.735
BREQ2			
Amotivation	0.801	0.809	0.890
External Regulation	0.762	0.881	0.762
Introjected Regulation	0.823	0.766	0.705
Identified Regulation	0.653	0.689	0.775
Intrinsic Regulation	0.887	0.708	0.912
PACES	0.957	0.928	0.943

Table 5. Means and Standard Deviations *M(SD)* for Cognitive Variables at Each Time Point

Scale	pre	post1	post2	N
Decisional Balance				
Pros	34.85 (5.58)	41.18 (7.56)	41.77 (7.48)	22
Cons	25.68 (4.64)	20.00 (5.94)	22.09 (4.42)	22
PCQ				
Cognitive	57.86 (7.92)	59.05 (9.56)	56.19 (11.87)	21
Consciousness Raising	16.52 (2.69)	17.42 (2.64)	15.57 (3.23)	21
Dramatic Relief	9.23 (3.09)	10.00 (3.13)	9.91 (3.85)	22
Environmental Re-evaluation	14.64 (3.24)	14.41 (3.36)	14.00 (3.94)	22
Self Re-evaluation	17.50 (2.60)	17.09 (2.79)	16.68 (2.80)	22
Behavioral	49.96 (14.41)	56.18 (18.76)	60.00 (8.98)	22
Counterconditioning	8.86 (3.09)	10.86 (2.51)	11.00 (2.35)	22
Helping Relationships	10.05 (4.39)	11.09 (3.61)	11.18 (4.53)	22
Reinforcement Management	12.14 (3.12)	14.23 (2.54)	14.41 (2.34)	22
Self-Liberation	9.95 (2.94)	12.23 (2.18)	12.59 (1.62)	22
Stimulus Control	8.95 (4.03)	9.77 (3.60)	10.82 (3.30)	22
SE	23.76 (7.06	22.96 (7.16)	26.57 (5.79)	21
BREQ2				
Amotivation	1.27 (1.67)	1.09 (1.77)	0.91 (1.66)	22
External Regulation	3.95 (3.24)	4.64 (3.50)	4.45 (2.89)	22
Introjected Regulation	6.10 (3.32)	6.45 (2.98)	6.35 (2.64)	20
Identified Regulation	10.67 (2.59)	11.05 (2.64)	10.67 (3.17)	21
Intrinsic Regulation	5.55 (2.80)	6.80 (2.78)	7.35 (2.89)	20
RAI	21.21 (19.67)	22.95 (18.72)	25.10 (15.41)	19
PACES	62.59 (22.94)	52.41 (15.87)	48.73 (17.99)	22
Intention	1.73 (1.40)	1.58 (0.98)	1.52 (1.16)	22

Table 6. Repeated Measures ANOVA Source Table for Cognitive Variables Over Time

Source	*df*	*SS*	*MS*	*F*	*P*
Decisional Balance, Pros (N = 22)					
Between Groups	2	654.212	327.106	16.192	<0.001
Within Groups	42	848.455	20.201		
Decisional Balance, Cons (N = 22)					
Between Groups	2	357.212	178.606	12.755	<0.001
Within Groups	42	588.121	14.003		
PCQ, Cognitive (N = 21)					
Between Groups	2	86.508	43.254	1.118	0.337
Within Groups	40	1548.159	38.704		
PCQ, Cognitive, Consciousness Raising (N = 21)					
Between Groups	2	36.222	18.111	3.030	0.060
Within Groups	42	239.111	6.978		
PCQ, Cognitive, Dramatic Relief (N = 22)					
Between Groups	2	7.848	3.924	1.083	0.348
Within Groups	42	152.152	3.623		
PCQ, Cognitive, Environmental Re-evaluation (N = 22)					
Between Groups	2	4.576	2.283	0.507	0.185
Within Groups	42	189.424	4.510		

(Table 6 Continued)

Source	*Df*	*SS*	*MS*	*F*	*p*
		PCQ, Cognitive, Self Re-evaluation (N = 22)			
Between Groups	2	7.364	3.082	1.758	0.185
Within Groups	42	87.970	2.095		
		PCQ, Behavioral (N = 22)[1] Wilks' Lambda = 0.588			
Between Groups	2			7.010	0.005
Within Groups	20				
		PCQ, Behavioral, Counterconditioning (N = 22)			
Between Groups	2	66.939	33.470	15.903	<0.001
Within Groups	42	66.939	66.939		
		PCQ, Behavioral, Helping Relationships (N = 22)[1] Wilks Lambda = 1.051			
Between Groups	2			1.051	0.368
Within Groups	20				
		PCQ, Behavioral, Reinforcement Management (N = 22)			
Between Groups	2	70.182	35.091	7.683	0.001
Within Groups	42	191.818	4.567		
		PCQ, Behavioral, Self-Liberation (N = 22)			
Between Groups	2	89.818	44.909	11.260	<0.001
Within Groups	42	167.515	3.988		
		PCQ, Behavioral, Stimulus Control (N = 22)			
Between Groups	2	38.394	19.197	3.481	0.040
Within Groups	42	231.606	5.514		
		SE (N = 21)			
Between Groups	2	161.848	80.924	3.297	0.047
Within Groups	42	1030.818	24.543		

(Table 6 Continued)

Source	*df*	*SS*	*MS*	*F*	*p*
		BREQ-2, Amotivation (N = 22)[1] Wilks' Lambda = 0.913			
Between Groups	2			0.958	0.401
Within Groups	20				
		BREQ-2, External Regulation (N = 22)			
Between Groups	2	5.485	2.742	0.613	0.546
Within Groups	42	187.848	4.473		
		BREQ-2, Introjected Regulation (N = 22)			
Between Groups	2	.1.300	0.650	0.189	0.829
Within Groups	38	130.700	3.439		
		BREQ-2, Identified Regulation (N = 21)			
Between Groups	2	2.032	1.016	0.273	0.762
Within Groups	40	148.653	3.716		
		BREQ-2, Intrinsic Regulation (N = 20)			
Between Groups	2	34.033	17.017	14.274	<0.001
Within Groups	38	45.300	1.192		
		BREQ-2, RAI (N = 19)			
Between Groups	2	144.667	72.333	0.943	0.399
Within Groups	36	2760.667	153.370		
		PACES (N = 22)[1] Wilks' Lambda = 0.722			
Between Groups	2			3.851	0.038
Within Groups	20				

[1] Wilks' Lambda values reported due to sphericity assumption violation.

APPENDIX A

Recruitment Flier

Interested in **Weight Loss**?

If you are like most people, you aren't getting as much physical activity as is needed for health and wellness. A student named Sasha Karnes from UW – Milwaukee needs your help to study an online program!

Frequently Asked Questions:

Q: Who is this for?
A: Adults who could use some help with getting more physical activity and who have e-mail.

Q: What would I have to do?
A: First, you'd answer some questions about yourself and wear a pedometer for a week. Then, you'd be e-mailed surveys and a physical activity program taking approximately 15 minutes per week for 4 weeks, then one more time 3 months later.

Q: What's in it for me?
A: A pedometer at no cost, a $50 gift card to Target if you complete all of the surveys over the course of 3-months, and possible weight loss.

Q: How can I find out more?
A: Provide your contact information below (for study purposes only) and Sasha will contact you within about a week!

1. What is your first and last name? _____

2. What is your e-mail address? _____

3. What is your telephone number?_____

4. What is your doctor's name at Aurora RiverCenter?_____

Thank you! Please give this form to your provider to answer the last question, or just give this form to the receptionist and Sasha will follow-up with your doctor for you.

APPENDIX B

Assessment Tools

Exercise Stage of Change

Please indicate whether the following statements are true or false for you by placing an "x" on the line. Note that *regular* exercise is defined as exercising 3 or more times per week for 20 minutes or more.

1. I currently do not exercise

____True ____False

2. I intend to exercise in the next 6 months

____True ____False

3. I currently exercise *regularly*

____True ____False

4. I have exercised *regularly* for the past 6 months

____True ____False

5. I have exercise *regularly* in the past for periods of at least 3 months.

____True ____False

Instructions for scoring:
If item 1 is true and 2 is false = precontemplation
If item 1 is true and 2 is true = contemplation
If item 1 is false and 3 is false = preparation
If item 3 is true and 4 is false = action
If item 3 is true and 4 is true = maintenance

*Stages of Change Questionnaire Adapted from: Marcus, B. H & Simkin, L. R. (1993). The stages of exercise behavior. *The Journal of Sports Medicine and Physical Fitness, 33,* (1), pp. 83-88.

Decisional Balance Questionnaire

1	1	2	3	4	5
"not at all important"					"extremely important"

Using the scale above, indicate how important each statement is with respect to your decision to not exercise.

____I would have more energy for my family and friends if I exercised regularly.
____I think I would be too tired to do my daily work after exercising.
____Regular exercise would help me relieve tension.
____I would find it difficult to find an exercise activity that I enjoy that is not affected by bad weather.
____Regular exercise would help me have a more positive outlook on life.
____I would feel more confident if I exercised regularly.
____I feel uncomfortable when I exercise because I get out of breath and my heart beats very fast.
____I would sleep more soundly if I exercised regularly.
____Regular exercise would take too much of my time.
____I would feel more comfortable with my body if I exercised regularly.
____I would feel good about myself if I kept my commitment to exercise regularly.
____I would have less time for my family and friends if I exercised regularly.
____I would like my body better if I exercised regularly.
____At the end of the day, I am too exhausted to exercise.
____I would feel less stressed if I exercised regularly.
____It would be easier for me to perform routine physical tasks if I exercised regularly.

*Adapted from Marcus, B. H., Rakowski, W., & Rossi, J. S. (1992). Assessing motivational readiness and decision making for exercise. *Health Psychology, 11*(4), 257-261.

Processes of Change Questionnaire

1	1	2	3	4	5
"never"					"repeatedly"

Using the scale above, think back over the past month and rate the frequency of occurrence of each of the following:

____I recall information people have personally given me on the benefits of exercise.
____I think about information from articles and advertisements on how to make exercise a regular part of my life.
____I read articles about exercise in an attempt to learn more about it.
____I look for information related to exercise.
____Warnings about health hazards of inactivity move me emotionally.
____Dramatic portrayals of the evils of inactivity move me emotionally.
____I react emotionally to warnings about an inactive lifestyle.
____I feel I would be a better role models for others if I exercised regularly.
____I wonder how my inactivity affects those people who are close to me.
____I realize that I might be able to influence others to be healthier if I would exercise more.
____Some of my close friends might exercise more if I would.
____I am considering the idea that regular exercise would make me a healthier, happier person to be around.
____I think about the type of person I will be if I keep exercising.
____I get frustrated with myself when I don't exercise.
____I consider the fact that I would feel more confident in myself if I exercise regularly.
____I find society changing in ways to make it easier for the exerciser.
____I am aware of more and more people encouraging me to exercise these days.
____I notice that more businesses are encouraging their employees to exercise by offering fitness courses and time off to work out.
____I am aware that many health clubs now provide free babysitting services to their members.
____Instead of remaining inactive, I engage in some physical activity.
____Rather than viewing exercise as simply another task to get out of the way, I try to use it as my special time to relax and recover form the day's worries.
____When I'm feeling tense, I find exercise a great way to relieve my worries.
____I have someone on whom I can depend when I am having problems with exercising.
____I have a healthy friend who encourages me to exercise when I don't feel up to it.
____I have someone who points out my rationalization for not exercising.
____I have someone who provides feedback about my exercising.
____I reward myself when I exercise.
____I try to set realistic goals for myself rather than setting myself up for failure by expecting too much.
____When I exercise, I tell myself that I am being good to myself by taking care of my body in this way.
____I do something nice for myself for making efforts to exercise more.
____I tell myself that I am able to keep exercising if I want to.
____I tell myself that if I try hard enough I can keep exercising.
____I make commitments to exercise.
____I remind myself that I am the only one who is responsible for my health and well-being, and that only I can decide whether or not I will exercise.
____I put things around my home to remind me of exercising.
____I keep things around my place of work that remind me of exercise.
____I remove things that contribute to my inactivity.
____I avoid spending long periods of time in environments that promote inactivity.

* Adapted from: Marcus, B. H., Rossi, J. S., Selby, V. C., Niaura, R. S., & Abrams, D. B. (1992). The stages and processes of exercise adoption and maintenance in a worksite sample. *Health Psychology, 11*(6), 386-395.

Physical Activity Self-Efficacy

Using the scale below, rate your level of confidence by writing the number that coincides with your choice on the line next to each item.

0	1	2	3	4	5	6	7
"does not apply to me"	"not at all confident"						"very confident"

I am confident that I can participate in regular exercise when:

____I am tired.

____I am in a bad mood.

____I feel I don't have time.

____I am on vacation.

____It is raining or snowing.

---

*Adapted from: Marcus, B. H., Selby, V. C., Niaura, R. S. & Rossi, J. S. (1991). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport, 63* (1), pp. 60-66.

EXERCISE REGULATIONS QUESTIONNAIRE (BREQ-2)

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples' decisions to engage, or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		Sometimes true for me		Very true for me
1	I exercise because other people say I should	0	1	2	3	4
2	I feel guilty when I don't exercise	0	1	2	3	4
3	I value the benefits of exercise	0	1	2	3	4
4	I exercise because it's fun	0	1	2	3	4
5	I don't see why I should have to exercise	0	1	2	3	4
6	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4
7	I feel ashamed when I miss an exercise session	0	1	2	3	4
8	It's important to me to exercise regularly	0	1	2	3	4
9	I can't see why I should bother exercising	0	1	2	3	4
10	I enjoy my exercise sessions	0	1	2	3	4
11	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
12	I don't see the point in exercising	0	1	2	3	4
13	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
14	I think it is important to make the effort to exercise regularly	0	1	2	3	4
15	I find exercise a pleasurable activity	0	1	2	3	4
16	I feel under pressure from my friends/family to exercise	0	1	2	3	4
17	I get restless if I don't exercise regularly	0	1	2	3	4
18	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
19	I think exercising is a waste of time	0	1	2	3	4

*Adapted from: Markland, D. & Tobin, V. (2004). A modification of the Behavioral Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology*, *26*, 191-196.

Physical Activity Enjoyment Scale

Please rate how you feel *at the moment* about the physical activity you have been doing by writing your response to each item on the blank next to each scale.

_____	1 I enjoy it	2	3	4	5	6	7 I hate it

_____	1 I feel bored	2	3	4	5	6	7 I feel interested

_____	1 I dislike it	2	3	4	5	6	7 I like it

_____	1 I find it pleasurable	2	3	4	5	6	7 I find it unpleasurable

_____	1 I am very absorbed in this activity	2	3	4	5	6	7 I am not at all absorbed in this activity

_____	1 It's no fun at all	2	3	4	5	6	7 It's a lot of fun

_____	1 I find it energizing	2	3	4	5	6	7 I find it tiring

_____	1 It makes me depressed	2	3	4	5	6	7 It makes me happy

_____	1 It's very pleasant	2	3	4	5	6	7 It's very unpleasant

_____	1 I feel good physically while doing it	2	3	4	5	6	7 I feel bad physically while doing it

_____	1 It's very invigorating	2	3	4	5	6	7 It's not at all invigorating

(Continues on Next Page)

(Continued)

	1	2	3	4	5	6	7
_____	I am very frustrated by it						I am not at all frustrated by it

	1	2	3	4	5	6	7
_____	It's very gratifying						It's not at all gratifying

	1	2	3	4	5	6	7
_____	It's very exhilarating						It's not at all exhilarating

	1	2	3	4	5	6	7
_____	It's not at all stimulating						It's very stimulating

	1	2	3	4	5	6	7
_____	It gives me a strong sense of accomplishment						It does not give me any sense of accomplishment at all

	1	2	3	4	5	6	7
_____	It's very refreshing						It's not at all refreshing

	1	2	3	4	5	6	7
_____	I felt as though I would rather be doing something else						I felt as though there was nothing else I would rather be doing

*Adapted from: Kendzierski, D. & DeCarlo, K. J. (1991). Physical activity enjoyment scale: Two validation studies. *Journal of Sport and Exercise Psychology, 10,* 50-64

Physical Activity Intention

Using the scale below, rate your agreement with the following statement.

1	2	3	4	5	6	7
"likely"						"unlikely"

I intend to engage in physical activity during the next two months.

---

*Adapted from: Ajzen, L., &, & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour*. Edgewood Cliffs, NJ: Prentice Hall.

IPAQ

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

(Continued next page)

IPAQ (Continued)

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ hours per day

_____ minutes per day

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ days per week

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ hours per day

_____ minutes per day

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ hours per day

_____ minutes per day

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

**Adapted from: http://www.ipaq.ki.se/downloads.htm*

APPENDIX C

Content of Web-based Program

Web-based Motivational Interviewing

- Initial web-visit would include surveys first and tutorial. Then enter the MI portion.

Overview:
-Session 1: Introductions, building rapport, exploring barriers, creating a discrepancy
-Session 2: Feedback, menu of options, eliciting change talk
-Session 3: Strengthening commitment to change, creating a discrepancy continued
-Session 4: Follow-up, building on and affirming change

Introductions and building rapport

"Welcome! Glad you decided to participate!"

"*Your doctor talked to you about your physical activity. What are some of your concerns about how much physical activity you are getting?"*

Insert a text box for response.

"*Those are certainly valid concerns. Thank you for sharing."*

"Now that you have shared your concerns, let's consider some of your thoughts about physical activity."

"*What are some reasons that you aren't getting as much activity as you or your doctor would like?"*

Insert text box for response.

"Those are difficult challenges to overcome, and you've done a great job thinking this through. It really is hard to get as much activity as is recommended. Describe, if you would, a time in the past when you were more active, or activities that you were able to do, and how those challenges fit in."

Insert text box as a response.

"You were able to work around your challenges in the past, with some success. What are some concerns that you're experiencing now, or that you might experience in the future if you continue at your current activity level?"

Insert text box for response

"Thank you for sharing. How might increasing your physical activity be a good thing for you?"

Insert text box for response.

"You are beginning to think through the positive aspects of being more active, even if it is a challenge. What, if any, are some other specific goals that being more active might help you to achieve?"

Insert text box for response.

"Those are good goals. Let's continue where we left off next week!"

Session II. -Feedback
-Eliciting change talk
-Menu of options (**Willing and Able Components of Model)**

"When you had your recent doctor visit, your doctor asked about how much activity you are getting. It turns out that you weren't getting quiet as much as is commonly recommended. If you're wondering what exactly those recommendations are, here is a link to some information that you can feel free to look at to see how your activity compares to what is recommended:"

http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html

How does your activity compare to what's recommended, either on this website or by your Doctor?

Insert text box for response

Elicit change talk **(Willing and Able Components of Model)**

"At this time, how important would you say it is for you to change your physical activity (on a scale from 0 to 10, where 0 is not at all important and 10 is extremely important?"

Insert text box for response.

"If not a 10, why not a 10 (Extremely Important)?"
Insert text box for response.

"*What would it take to get you to a higher number, if you weren't at 10?"*

Insert text box for response.

"You might feel like changing your physical activity has some importance and that's good. Now, let's consider how confident you feel that you can make changes in your physical activity."

"How confident are you, on a scale from 1 to 10 that you can make changes in your daily activity?"
Insert text box for response

"If not a 10, why not a 10?"

Insert text box for response

"What would it take to get you to a higher number, if you weren't at a 10?"
Insert text box for response

"It's hard work to think about change, and you are doing a great job!"

"Thank you for your time.

"In terms of getting to being more active, what do you think might be some next steps for you?"

Insert text box for response

"*Those sound like good next steps."*

"What are some ideas that you have about activities that you'd find manageable or possibly even enjoyable?"

Insert text box for response

"Great, you've got some ideas for ways to be more active. Some people decide to take the stairs instead of the elevator, and prefer to make small changes that fit into their daily routine, while other folks prefer to get a gym membership and to start taking classes. If you'd like, here is a website with some activity recommendations, which you can feel free to visit to look into more options for activities that might be enjoyable or at least manageable for you...
http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html.

"Also, believe it or not the most common physical activity is walking. For some people, walking instead of driving or taking public transportation is one possible way to get more physical activity into their daily routine. Still others find that taking a walk during leisure time can be a good way to not only meet physical activity needs, but also to make time to socialize with someone they enjoy spending time with. Maybe you'll consider going for an extra walk today? Remember – it's just one of the many ways to get more physical activity."

"You are on track to figuring out what will work for you. Let's consider this some more next week!"

Session III. -Strengthening the Commitment to Change
-Creating a Discrepancy Continued (**Readiness Component of Model).**

"*Thanks for coming back! Last time, we talked about some ideas for activities that might work for you, and how committed you are to making a change to being more active. On a scale from 0 to 10, where 10 is not at all committed and 10 is extremely committed, at this time?"*

Insert text box for response.

"If not a 10, why not a 10?"

Insert text box for response

"What would it take you to get to a higher number, if you weren't a 10?"

Insert text box for response

"It's hard work to think about change, and you've done some good thinking about where things stand for you right now."

"If you are ready, we can make a plan that will help you to reach your goals. Based on your ideas for activities that will work for you, when might you start and, where and how will you start to be more active?"

Insert text box for response.

"*That's great! Remember, that sometimes you won't stay exactly on track with your plan and little lapses are expected. Even though this is not uncommon, temporary difficulties can be a good opportunity to consider how to better manage them in the future. Now though, you're on your way to feeling better and meeting your goals!"*

"Let's check in next week so that you can share how your plan for when, where and how to be more active worked out."

Session IV. -Follow-Up
-Building on and Affirming Change

"Thanks for coming back! Although this web-program is almost complete, over the last couple of weeks we've covered a lot! For instance, you mentioned reasons that you might want to be more active, and explored ways to overcome challenges that you face. Last time you came up with some ideas in terms of specific plans for being more active. How did that work out for you?"

Insert text box for response.

"How did you manage challenges and anything that made it difficult at times to be active?"

Insert text box for response.

"What was a success that you had, in terms of being more active?"

Insert text box for response.

"*Realizing challenges and making an effort to overcome them is a great start. You may have had some success, which shows you're capable of making changes. Good for you! What are your plans for activity for the near future (i.e. this next week)?"*

Insert text box for response.

"That sounds like a good plan. It's good to set goals that are within your own limits. What about a plan for more activity for the longer term future (i.e. the coming months)?"

Although this web-based program is complete, your Doctor will be glad to hear that you've thought through, and maybe even tried some ways to be more physically active. Sticking with your plan, and revising your plan as you find what works best for you, and what you prefer, will help you to reach your goals. Congratulations, and keep up the good work!"

Curriculum Vitae

Sasha L. Karnes

Contact Information
University of Wisconsin – Milwaukee
Enderis Hall, 10th Floor
2400 E. Hartford Ave. Milwaukee, WI 53211

Formal Education:

2004 – Present	Health Science Ph.D., University of Wisconsin – Milwaukee Concentration: Psychology and Exercise Physiology Dissertation Topic: Motivational Interviewing for Physical Activity Promotion, GPA: 3.92, Dissertator as of Spring, 2007
2004	Health Psychology M.S., University of Wisconsin – Milwaukee Concentration: Social aspects of health psychology, GPA: 3.97
2002	Psychology B.A., University of Wisconsin – Milwaukee Cumulative G.P.A.: 3.93

Graduate and Undergraduate Teaching Experience:

Spring 07/08 - Present	SSW – 793, "Advanced Methods of Social Welfare Research", Graduate University of Wisconsin - Milwaukee
Spring 09-/10 - Present	CHS-245: "Cultural Diversity for Health Care Professionals", Undergraduate University of Wisconsin - Milwaukee
Fall 10/11 – Spring 11/12	KIN – 270 :Statistics for Health Professionals", Undergraduate University of Wisconsin - Milwaukee
Fall 07/08- Summer 09/10	SSW – 662, "Research Methods for Social Workers", Graduate & Undergraduate University of Wisconsin-Milwaukee

Guest Lectures and Trainings

November, 2008, Octobers 2009 -2012	Guest Lecture, Invited, HMS 780, Topic: *Motivational Interviewing for Health Care Providers*
February, 2009 & February,2010	Guest Lecture, Invited, HMS 645, Topic: *Psychological Theories of Behavior Change for Physical Therapists*
November, 2008	Training workshop, presenter and participant, Topic: *Motivational Interviewing*
October, 2008	Guest Lecture, Invited, HMS 550, Topic: *Theories and Applications of Behavior Change*
April, 2008	Guest Lecture, Invited, HMS 430, Topic: *Motivational Interviewing and Theories of Behavior Change*
January& June, 2006	Guest Lecture, HMS 350, Topic: *Motivation in Sport and Exercise Psychology*
October, 2005	Training workshop, Certified in Motivational Interviewing techniques

Research and Scholarship

1. **Karnes, S.** (2012). *Investigation of Web-based Motivational Interviewing to Increase Physical Activity Participation Among Adults.* Presentation at College of Health Sciences Research Symposium, Milwaukee, WI, December 7.

2. Berger, L. K., Sedivy, S. K , Hernandez – Meier, J., **Karnes, S.** (2010). Employee Alcohol use: Factor analysis of the general work stress paradigm. *Journal of Workplace and Behavioral Health, 25, 2,* 146-153.

3. Haertlein Sells, C., Dupont, P., **Karnes, S**., Ohrmund, D. (2009). *A Brief Group Intervention to Reduce Alcohol Use Among Residence Hall Freshmen*. Poster presented at Center for Addiction and Behavioral Health Research Conference, Milwaukee, WI, May 18.

4. Haertlein Sells, C., Dupont, P., & **Karnes, S**. (2007). *Comparing Two Interventions for Freshman Violators* (2007). Invited presentation at the NIAAA Steering Committee Meeting for Rapid Response to College Drinking. Washington, D.C. February 8.

5. **Karnes (nee White), S**. (2004). *Media Exposure and Weight- Related Cognitions in the Prediction of Weight Control Behavior.* Master's thesis submitted in partial fulfillment of degree requirements. Milwaukee, WI, May.

6. Sable, H.J.K., **White, S. L.**, & Steinpreis, R. E. (2004). Effects of chronic naltrexone treatment in rats on place preference and locomotor activation after acute administration of cocaethylene or ethanol plus cocaine. *Alcohol, 33* (1) 51-61.

7. Sable, H.J.K., **White, S. L.,** & Steinpreis, R. E. (2002). *The Effects of Naltrexone Implants on the Conditioned Place Preference of Cocaethylene and the Coadministration of Ethanol and Cocaine in Rats.* Presented at Midwest Psychological Association Conference, Chicago, IL, May 3.

University Activities and Awards

Fall, 2012	Second place winner of UWM Research Symposium Podium Presentation Competition, Award Amount $200
Fall 2012- Spring 2013	Recipient Chancellor's Graduate Scholarship Award, Award Amount $22,582
Fall 2010	Recipient of UWM Chancellor's Graduate Student Award, Award amount $2000
Spring 2009	Recipient of College of Health Sciences Student Research Grant Award, Award Amount $500
Fall 2008 – Spring 2009	Committee member Search and Screen for Dean of the College of Health Sciences, Nominated student representative
Fall 2008	Subcommittee member of the *AODA* Task force, Enlisted to review online alcohol programming to inform University Housing purchase decision
October, 2006	Graduate student of the month
2006- 2007	Human Movement Sciences Graduate Student Association President
2005-2006	Human Movement Sciences Graduate Student Association Secretary

Assistantships and Professional Experience:

5/2002-present Program Evaluator & Clinical Coordinator, Midwest Rehabilitation Associates – Wauwatosa, WI
Medical report writer and principle outcome data evaluator and manager.
Duties include:
-Generate collaborative discharge summaries in an interdisciplinary pain management clinic
-Compile outcome data and generate reports
-Prepare materials for credentialing boards

6/2010 – 12/2011 Consultant, University of Wisconsin – Milwaukee
Collaborator for physical activity promotion website development for research grant project
Duties include:
-Establish theory-based website content
-Draft website flow diagrams

8/2005-6/2009 Project Assistant, University of Wisconsin – Milwaukee
National Institute of Health grant to investigate college student drinking in a randomized controlled trial with long-term follow-up.
Duties include:
-Oversee project operations including data entry and staff adherence to study protocol
-Conduct data analysis, intake assessments, and event monitoring
-Correspond with collaborating departments and personnel
-Generate reports and present findings