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Mindfulness as a moderator of coping response and the Abstinence Violation Effect : a test of the role of mindfulness in the Relapse Prevention Model for exercise.

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MINDFULNESS AS A MODERATOR OF COPING RESPONSE AND THE ABSTINENCE VIOLATION EFFECT: A TEST OF THE ROLE OF MINDFULNESS IN THE RELAPSE PREVENTION MODEL FOR EXERCISE

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DEDICATION

This dissertation is dedicated to my parents

Mrs. Margaret Elizabeth Ulmer and Mr. Kenneth James Ulmer

whose commitment to the well-being and nurturing of their children assured that all of us had opportunities unavailable to them. They gave themselves to work well done and by their example we have gone into the world to do the same. Their continued support and encouragement made possible this present accomplishment. For this, and for the trajectory of my life, with the aim of good work and service to others,

I am eternally grateful to Margaret and Kenneth.

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ABSTRACT

MINDFULNESS AS A MODERATOR OF COPING RESPONSE AND THE ABSTINENCE VIOLATION EFFECT: A TEST OF THE ROLE OF MINDFULNESS IN THE RELAPSE PREVENTION MODEL FOR EXERCISE

Christi S. Ulmer

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The importance of physical activity in preventing disease and promoting health is increasingly evident in health outcomes research. Although most adults in the U.S. have initiated exercise programs at some point in their lives, research suggests that they have difficulty maintaining beneficial levels of physical activity and exercise. With escalating rates of obesity and physical inactivity, the importance of understanding processes by which individuals engage in and maintain physical activity cannot be understated. The Relapse Prevention Model (RPM), developed for use with addiction, has been successfully used to explore factors associated with exercise drop-out, or "exercise relapse". In the current study, relationships between constructs of the RPM were examined and the role of mindfulness in moderating these relationships was evaluated using retrospective recall of exercise. In this cross-sectional study, static constructs were used as proxies for the situationally defined constructs of the RPM and the sequelae of high-risk situations for exercise lapse. Mindfulness was predicted to moderate the relationships between vulnerability to relapse and coping response, and between slip

frequency and the Abstinence Violation Effect (AVE) in lapsers, such that individuals who were higher in mindfulness would endorse more effective coping strategies and lower AVE. The findings of this study suggest that mindfulness may be associated with better exercise outcomes, that less mindful community exercisers may use certain ineffective coping strategies more often, and that mindfulness may buffer the relationship between missed exercise sessions and the AVE. Future research on the role of mindfulness in exercise is recommended using prospective assessment methodologies and longitudinal design.

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INTRODUCTION

The Benefits of Physical Activity

Over the previous decade, the benefits of engaging in regular physical activity have become widely accepted and recommendations for physical activity are a standard component of responsible clinical health care (Marcus, Dubbert, Forsyth, McKenzie, Stone, et al., 2000). Physical activity has been associated with reduced a risk for developing various chronic illnesses, such as non-insulin-dependent diabetes mellitus, hypertension, obesity and coronary heart disease (CDC/ACSM, 1995), and with mediators of health such as high-density lipoprotein levels, serum triglyceride levels, and cardiovascular risk factors (Blair, Kohl, Paffenbarger, Clark, Cooper, et al., 1989). Interventions designed to increase physical activity have revealed similar benefits in chronic disease populations. An example of the efficacy of physical activity for disease prevention was demonstrated in the landmark Diabetes Prevention Program, a randomized controlled trial of patients at risk for the development of DM. In this study, a lifestyle intervention program including at least 150 minutes of physical activity per week significantly reduced the incidence of DM by 58% as compared to a 31% reduction with medication alone (Diabetes Prevention Program Research Group, 2002).

The psychological benefits of physical activity are also well established for depressive symptoms, anxiety and stress (Salmon, 2000, Dishman & Buckworth, 1997), and these benefits are observed across varying levels of intensity and settings (home-

based versus exercise facility) (Marcus, Simkin, Rossi, & Pinto, 1996). In a recent cross-sectional study of adults recruited from an urban YMCA, a public university, and community centers in Louisville, Kentucky, consistent exercisers reported lower depression, tension, anger, and fatigue and more vigor than less consistent exercisers, including both intermittent and non-exercisers (Stetson, Beacham, Meyer, Bonner, Ulmer, et al., 2004). Evidence suggests that acute bouts of physical activity are followed by reductions in anxiety lasting as long as 5 hours following the activity (Raglin, Morgan, & Luchsinger, 1990). Post-exercise reductions in negative cognitions, including negative automatic thoughts and dysfunctional attitudes, have been observed as well (Lash, 2000). It should be noted that the terms "physical activity" and "exercise" are often used interchangeably in the literature. Strictly speaking however, physical activity encompasses lifestyle and work activities, whereas exercise is a specific type of physical activity that is purposeful and often involves an exercise program or regimen (Marcus, Bock, & Pinto, 1997).

The mounting evidence for the health benefits of physical activity prompted the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) to issue a combined recommendation that "all Americans engage in at least 30 minutes of moderate physical activity on most, and preferably, all days per week (CDC/ACSM, 1995)." However, a high percentage of Americans (approximately 25%) report no leisure time physical activity (Centers for Disease Control and Prevention, 2001; Dubbert, 2002), and less than one-quarter of healthy American adults comply with the CDC/ACSM guidelines for physical activity (U.S. Department of Health and Human Services, 2000; Stetson, Beacham, Frommelt, Boutelle, Cole, et al., 2005). The effects of

physical inactivity among adults in the U.S. are observed in the findings of the 2001 Behavioral Risk Factor Surveillance System (BRFSS) survey (N=175,850) which revealed that adults who attained recommended physical activity levels were significantly less likely to report 14 or more unhealthy days, either physical or mental, over the previous 30 day period regardless of ethnicity, age or gender, as compared to physically inactive adults. This finding held even among individuals with chronic health issues such as arthritis (Brown, Balluz, Heath, Moriarty, Ford, et al., 2003).

Based upon cross-sectional data of exercise status suggesting that only about one-quarter of adults are physically active, public health agencies may be prompted to initiate programs intended to encourage exercise initiation. However, longitudinal studies and those investigating history of exercise reveal that a large proportion of adults have initiated exercise in the past and have relapsed. In a study of randomly selected residents of San Diego, California, 40.9% of participants reported one or more episodes of dropping out of exercise, and 21% reported 3 or more exercise drop-out episodes (Sallis, Hovell, Hofstetter, Elder, Faucher, et al., 1990). Other studies suggest that 50% of adults, both male and female, are likely to drop out of exercise within 6 months of initiation or will fail to maintain physical activity at the intended level (Dishman, 1988; Marcus, Bock, & Pinto, 1997).

Intermittent Exercise

Although the percentage of individuals within a longitudinal sample who are currently exercising is likely to remain consistent over time, an idiographic view of the sample suggests that the observed consistency in percentages of current exercisers may not represent exercise maintenance on an individual basis (Sallis, et al., 1990). Few

longitudinal studies of exercise maintenance have been conducted, and those that have suggest that many individuals who engage in exercise do so on an intermittent basis (Buckworth & Dishman, 2002, Bock, Marcus, & Pinto, 2001). In a cross-sectional study of adults recruited from an urban YMCA facility, 48.1% described their exercise pattern as "on and off" or "rarely" (Stetson, et al., 2004). In a longitudinal study of adults recruited from urban exercise facilities in Chicago, Illinois, 63.4 % of participants were found to have missed at least one week of exercise and 15.2% were found to have missed 3 or more weeks of exercise over a 6-month period (Stetson, et al., 2004). At the twelve-month follow-up, 29.9% were not exercising regularly. In another study of community exercisers at a YMCA facility (N=7135), 81% of participants were found to have missed a week of exercise over the course of a one-year period (Marcus, et al., 2000). The evidence available thus far suggests that, among U.S. adults, intermittent exercise is largely the rule rather than the exception, underscoring the importance of determining factors that predict exercise adherence and maintenance.

Determinants of Physical Activity and Adherence

Factors associated with patterns of physical activity (PA) are generally classified into one of three categories: personal characteristics; psychological factors; and environmental factors (Marcus, et al., 1997). Personal characteristics associated with PA include demographic factors such as ethnicity, education, age and body mass index. Psychological factors associated with PA include self-efficacy for exercise, "self-motivation, belief in the health benefits of exercise, perceptions of being in good health, and perceived exercise enjoyment (pg. 337)." Psychological barriers include lack of time, being too tired or too weak, fear of injury, bad weather, lack of exercise facilities,

and lack of exercise partners (Trost, Owen, Bauman, Sallis, & Brown, 2002). Environmental factors associated with PA include social support and access to exercise facilities including convenience, cost and intensity of available programs. Table 1 is a summary of the factors that have consistently emerged as being associated with overall physical activity in U.S. adults (pg. 1997, adapted from Trost, et al., 2002).

Self-efficacy and decisional balance (perception of the pros and cons of a behavior) are important cognitive predictors of and potent barriers to PA (Marcus, et al., 1997). Self-efficacy is the most consistent correlate of physical activity (Trost, et al., 2002) and has been shown to be an independent predictor of exercise adoption and adherence (Bandura, 1997; Marcus, Selby, Niaura, & Rossi, 1992b). Motivational readiness is another cognitive factor in PA, as individuals who are in a lower stage of motivational change (Transtheoretical Model: Prochaska, & DiClimente, 1983) are less likely to engage in a behavior (Marcus, et al., 1992a). Progression along the motivational continuum (moving from the contemplation stage to the action stage in the Transtheoretical Stages of Change model) across the course of PA interventions has been associated with increased engagement in physical activity (Bock, et al., 2001), and those who perceive more benefits in exercise than detriments are most likely to participate in physical activity (Marcus, et al., 1997).

With some exceptions, recent research suggests that determinants of PA vary little across populations assessed thus far, and that cross-sectional study findings are largely consistent with prospective study findings (Trost, et al., 2002). However, interactions between the factors cited in Table 1 have been found to be associated with PA, particularly among women. For example, being female and African American is

associated with being less active, and in a sample of African American church members, a sense of affiliation was associated with exercise program attendance (Izquierdo-Porrera, Powell, Reiner, & Fontaine, 2002). Environmental barriers tend to have the greatest impact on women and low-income individuals, and peer social support among women seems particularly important (Etkin, 1994; Marcus, et al., 1997). Other barriers that are particularly salient to women's participation in exercise include having children, lack of time and energy, age, and lack of social support (Sallis, Hovell, & Hofstetter, 1992; Verhoef, Hamm, & Love, 1993). Among underserved populations, low-income and minority status individuals are less likely to be physically active than the general population (Marcus, et al., 1997).

Theoretical Model of Health Behavior

An understanding of the complex processes involved in PA behavior change is facilitated by theories such as Learning theory (Skinner, 1953), Social-Cognitive theory (Bandura, 1977), the Transtheoretical model and Stages of Change theory (Prochaska & DiClimente, 1983) and the Relapse Prevention Model (Marcus, King, Bock, Borrelli, & Clark, 1998; Marlatt & Gordon, 1985). There is a considerable body of empirical evidence supporting the application of theoretical models to exercise and PA (Marcus, et al., 1997), and the use of models reflecting processes of change are encouraged over models that simply classify individuals as adherent or non-adherent (Sonstroem, 1988). Among the various models used to conceptualize exercise behavior, only the Relapse Prevention Model (RPM) focuses specifically on processes of lapse and relapse from a target behavior. The RPM is posited to be uniquely applicable to exercise drop-out processes due to its conceptualization of relapse as a process rather than an event (King

& Frederiksen, 1984; Marcus, et al., 1997; Marcus et al., 1998; Martin & Dubbert, 1984; Martin, Dubbert, Katell, Thompson, Raczynski, et al., 1984; Stetson, et al., 2005).

Overview of the Relapse Prevention Model

The RPM was developed as a model of behavioral, environmental and cognitive processes that contribute to relapse from substance use abstinence. This model (Figure 1), developed by Marlatt and Gordon (1985), is one of the most widely used models to explain processes of abstinence and relapse in the addiction literature (Larimer, Palmer, & Marlatt, 1999). Marcus and colleagues propose that the RPM may be equally applicable to relapse from positive behaviors, such as exercise, as negative behaviors in that "the goal of relapse prevention is to help people who are attempting to modify their behavior to learn to anticipate, avoid, and if necessary, cope with situations that may lead to a return to the problem behavior (pg. 343, Marcus, et al., 1997)."

The RPM posits that relapse episodes are precipitated by two categories of factors including, immediate determinants and covert antecedents (Larimer, et al., 1999). The model shown in Figure 1 (Marlatt & Gordon, 1985) depicts the immediate determinants of relapse. Relapse, as conceptualized by Marlatt is "a transitional process, a series of events that may or may not be followed by a return to baseline levels of the target behavior (pg. 32)." In contrast with common all-or-none (abstinence vs. relapse) conceptualizations of relapse in clinical settings, Marlatt emphasizes the importance of cognitive and behavioral processes that ensue both before and after lapse and relapse.

High-Risk Situations

In the RPM, an individual who is successfully initiating behavior change has attained some level of compliance with rules governing the target behavior. The

individual feels a sense of control and confidence regarding their ability to maintain the behavior, until a high-risk situation is encountered. A high-risk situation is any situation that threatens the individual's sense of control and increases the likelihood of relapse. Based upon addiction research, Marlatt (1996) proposed four categories of high-risk situations including: negative emotional states in response to cognitions or environmental circumstances; interpersonal high-risk situations, such as interpersonal conflict; social pressure including both direct verbal and nonverbal persuasion; and positive emotional states in which cues, such as social gatherings, elicit cravings for substance use.

Coping Response

Coping in response to the high-risk situation can take the form of either a coping response or a no-coping response. Coping responses are cognitive or behavioral strategies utilized by the individual to negotiate a high-risk situation, and an effective coping response is any response that facilitates successful negotiation of high-risk situations without substance use. An example of a behavioral coping response is leaving a situation in which environmental cues elicit cravings, and positive re-framing in the face of a negative emotional state is a type of cognitive coping response.

Self-Efficacy

In accordance with Bandura's Social Learning Theory, self-efficacy is an individual's belief in their ability to effectively perform a behavior. In the RPM, effective coping responses result in a sense of confidence, or self-efficacy, in being able to effectively cope with future high-risk situations. Having successfully negotiated the high-risk situation in the past, the individual has a sense of knowing that they can handle similar situations. Self-efficacy increases with each consecutive instance of successful

negotiation of a high-risk situation, and as a variety of high-risk situations are negotiated, self-efficacy may generalize to a variety of situations. Similarly, self-efficacy decreases with an ineffective coping response.

Outcome Expectancies

Outcome expectancies are a person's belief regarding the immediate effects of engaging in a behavior, and are posited to function in tandem with self-efficacy in the RPM. The valence (positive or negative) of the expected outcome of a behavior is associated with the likelihood of engaging in that behavior, such that anticipation of immediate gratification or positive effects are more likely to elicit the behavior than the converse. Positive outcome expectancies may also take the form of attending only to immediate consequences in the absence of considering longer-term effects.

Abstinence Violation Effect

The combined factors of low self-efficacy and positive outcome expectancies for substance use are likely to be followed by initial use of a substance, or a "lapse". The cognitive and affective state that follows initial use is largely related to the individual's perceived cause for the lapse. If the individual has adopted a traditional characterization of abstinence from substance use as an all-or-none process in which a single episode of substance use is complete failure, they are more prone to experience the Abstinence Violation Effect (AVE). Determinants of the AVE include the strength of prior commitment, the duration of abstinence, and the presence of significant others. The AVE is has been defined as, "a dimensional construct that comprises two factors: (a) causal attribution of responsibility for the slip and (b) an affective reaction to the attribution (Curry, Marlatt & Gordon, 1987, pg. 145)." More specifically, the AVE is characterized

by: a perceived loss of control regarding abstinence; internal, global and stable attributions regarding the cause of initial substance use; and an affective reaction including guilt and distress. Situational and external antecedents are not considered. Cognitions are predominantly negative and perceived control for abstinence decreases considerably and generalizes across situations. The likelihood of relapse following initial use is a function of the strength of the AVE in response to the lapse.

Relapse Replication and Extension Project (RREP)

Due to the widespread use of Marlatt's RPM in addiction interventions, the National Institute of Alcohol Abuse and Alcoholism instituted a replication and extension study to assess Marlatt's taxonomy for classification of relapse episodes (Lowman, Allen, Stout, & the Relapse Research Group, 1996; Witkiewitz & Marlatt, 2004). In response to criticism regarding the predictive validity of the model and the findings of the RREP, Marlatt and colleagues developed a revised cognitive-behavioral model of relapse that places greater emphasis on the reciprocal interactions between various factors in predicting relapse to alcohol use (Witkiewitz & Marlatt, 2004). The findings of the RREP provided empirical support for many of the RPM constructs (Lowman, et al., 1996) including the AVE and the importance of coping response and negative affect in predicting relapse (Witkiewitz & Marlatt, 2004).

Conceptualizing Exercise Status

Consistent with theoretical models of health behavior change, it is common to speak of PA behavior change as a process delimited by certain milestones including initiation, adoption, adherence, and maintenance of the new behavior (King, 1994; Knapp, 1988). With respect to exercise and PA, early research has focused on issues of

adoption and adherence to exercise using cross-sectional and intervention studies (Stetson, et al., 2005). Researchers are beginning to identify factors that are consistently associated with exercise adherence, which is often defined as having met the CDC/ACSM recommendations for PA (Marcus, et al., 2000). However, the factors that determine longer term adherence, or "exercise maintenance", are poorly understood.

Attempts to define exercise status in long-term exercisers are hindered by the limited number of longitudinal studies assessing patterns of exercise. PA researchers have typically adopted a criterion of 6 months of regular exercise as constituting exercise maintenance (Bock, et al., 2001; Dunn, Marcus, & Kampert, 1999; Marcus et al., 1992a; Stetson, et al., 2005). The 6-month designation is based on the Transtheoretical Model Stages of Change criterion of 6 months sustained behavior change as the criterion for entering the maintenance stage (Prochaska, DiClimente, & Norcross, 1992, Prochaska & Marcus, 1994, 1992, Prochaska, Redding, & Evers, 1997). Although the 6-month criterion has some predictive validity in predicting future behavior, longitudinal studies exploring the extent to which lesser periods of sustained behavior are predictive of future behavior are lacking.

Consistent with the RPM, "exercise relapse" (Knapp, 1988) is conceptualized as being a process rather than an event, involving a series of cognitive, behavioral, and affective antecedents (Marcus, et al., 1997). Accordingly, relapses are preceded by "lapses" and "slips". An exercise slip has been defined as the omission of a single exercise session, a lapse has been defined as a 1-week period without exercise, and an exercise relapse has been defined as either a 3-week or 3-month period without exercise (the latter, following a period of 6 months of regular exercise) (Sallis, et al., 1990;

Stetson, et al., 2005). In a recent study, researchers attempted to define exercise status in terms of exercisers' perceptions of lapse and relapse and assess their validity in predicting longitudinal exercise behavior (Stetson, et al., 2004). In this sample of female community exercisers, participants perceived a period of 2 weeks without exercise (modal response) to be an exercise lapse, and a period of 3 months without exercise to be an exercise relapse. Ongoing data analyses are being conducted to assess the predictive validity of these exerciser-defined characterizations of lapse and relapse.

Determinants of Exercise Relapse

In a study of long-term exercisers in a Midwestern YMCA exercise facility, self-identified high-risk situations for exercise relapse included bad weather, time of day, being alone, negative emotions, and fatigue. Positive coping strategies were associated with exercise adherence, regardless of gender. Among men, guilt and perceived control for high-risk situations were associated with exercise outcomes at follow-up (Stetson, et al., 2005). In a large cross-sectional study of lifetime history of exercise relapse (N=1811), low exercise self-efficacy was found to have the strongest association with relapse history (Sallis, et al., 1990). In other studies, relapsers were found to have fewer coping strategies for high risk situations than exercise maintainers (Simkin & Gross, 1994) and exercisers employing relapse prevention strategies had greater success with adherence to a PA program (Belisle, Roskies, & Levesue, 1987; King, et al., 1984; Marcus et al., 1998). In a sample of cardiac rehabilitation patients, patients who had regressed to lower levels of exercise at the 3-month follow-up were found to have more negatively-valenced decisional balance scores, lower self-efficacy and less frequently endorsed behavioral processes of change compared to patients who were maintaining or

progressing (Bock, Albrecht, Traficante, Clark, Pinto, et al., 1997). In a review of predictors of relapse in addictive behaviors, negative emotional states were consistently found to predict lapse and relapse (Brownell, Marlatt, Lichstein, & Wilson, 1986) Cognitive and behavioral coping skills, self-efficacy, and physiological, environmental and social factors were determinants of lapse and relapse as well.

Application of Relapse Prevention Model to Health Behaviors

The RPM has been used in other areas of research as well, including health behavior change interventions targeting weight management, diabetes management and smoking cessation. Using hypothetical high-risk situations at baseline, dieters were able to accurately predict high-risk situations that would ultimately result in relapse, and the participants who provided a greater number of coping responses to baseline hypothetical high-risk situations lost more weight at follow-up (Drapkin, Wing, & Shiffman, 1995). In abstinent smokers, participants who relapsed following a lapse reported greater AVE scores (causal attributions for lapse) than participants who returned to abstinence (Curry, et al., 1987), AVE was found to be the strongest predictor of relapse (Curry, et al., 1987), and the latency between lapse and return to daily smoking was associated with self-efficacy at baseline, and affect at the time of the first cigarette (Brandon, Tiffany, Obremski, & Baker, 1990). In obese Type 2 diabetics, both cognitive and behavioral coping strategies were associated with positive outcomes (Grilo, Shiffman, & Wing, 1989).

Application of RPM to Exercise

The RPM has been employed in only a few studies of exercise adoption, adherence and relapse with mixed results. These studies involved assessment of various

RPM components rather than assessment of fit of the model. In a study of sedentary adults (N=35) (Martin, & Dubbert, 1984), participants were randomized into one of three programs: a relapse prevention program; a basic program involving distraction from the discomforts of exercise; and relapse prevention with post-intervention continued contact. The relapse prevention and relapse prevention plus contact groups had a planned relapse of one week without jogging as part of the intervention. No differences between groups were found for exercise maintenance at follow-up. The findings of this study were, however, confounded by continued contact with research assistants following program completion, and by social and exercise support interactions that occurred between members of the relapse prevention only group.

In a randomized controlled trial of college women (N=58) (King & Frederiksen, 1984), female joggers were assigned to one of four conditions including: group support and relapse treatment; group support only; relapse prevention only; and control condition. Participants receiving group support or relapse treatment were found to have double the number of jogging episodes compared to the control condition. A significantly greater percentage of participants in the individual Relapse Treatment condition were found to be jogging at three-month follow-up compared to the other active treatment conditions.

In a study of adults enrolled in 10-week exercise groups at a university sports center (N=350) (Belisle, et al., 1987), participants in the experimental group were provided with an educational program involving self-management, awareness of obstacles to exercise, high-risk situations, management of lapses, and the abstinence violation effect. Compared to controls, the experimental group attended a significantly

greater number of sessions, and these findings were replicated one year later (Foster, 1994).

In a study of previously sedentary women (N=120) (Marcus & Simkin, 1993), participants were randomly assigned to a relapse prevention program, a reinforcement program and an exercise-only control group. Following an 18-week intervention period, 72% of participants across all conditions had dropped out of the program. Attendance was, however, significantly higher during the first half of the program for participants in the relapse prevention group than controls.

Coping responses to high-risk situations and subsequent relapse patterns were assessed in a study of women who had recently joined a health club (N=29) (Simkin & Gross, 1994). Exercise lapses of 1 week and 3 weeks missed exercise were observed in 66% and 41% of participants, respectively, over a 9-month assessment period. Participants were presented with 10 high-risk situations for exercise relapse, and were asked to provide a list of strategies they would employ to meet their planned exercise goal. Participants who relapsed within the 14-week study period (3 weeks without exercise) generated significantly fewer cognitive and behavioral coping strategies at baseline.

In a study of female exercisers recruited from health clubs (N=82) (Stetson, Rahn, Dubbert, Wilner, & Mercury, 1997), participants kept a diary of stressors and exercise on a daily basis for a period of eight weeks. In tandem with the literature on stress and health, the RPM was cited as a theoretical basis for the study with coping response to stressful daily events predicting exercise adherence. Researchers explored the impact of minor stressors on exercise adherence in accordance with recent stress and health

research suggesting that the cumulative effect of minor stressors may have greater adverse health impacts than major life stressors. Researchers found that higher perceived stress was associated with less frequent exercise, omission of planned exercise sessions, and lower self-efficacy for meeting exercise goals.

Marcus and colleagues (Marcus, et al., 1997) note that findings for the earlier intervention studies are confounded by various methodological limitations and problems including: conducting follow-up assessments only on adherent participants; presentation of RP strategies at only a single session; nonrandom assignment; the inclusion of a planned relapse before the behavior had been fully adopted, and failure to comply with study protocols by group leaders.

In a more recent study, patterns associated with exercise slips were assessed in a sample of long-term community exercisers and were compared with relevant RPM constructs (Stetson, et al., 2005). Gender differences on predictors of exercise outcomes were also examined. Figure 2 is an adapted version of the RPM to describe processes of exercise, lapse, relapse and maintenance (Stetson, et al., 2004). In accordance with previous research on exercise and diet, coping strategies employed in response to high-risk situations were classified as either cognitive or behavioral. Task-oriented problem-solving and positive reappraisal were coded as positive cognitive coping strategies in accordance with stress and coping research and with Marlatt's research on substance use relapse. At baseline, women were more likely to report a slip, they endorsed more guilt in response to high-risk situations and they utilized more coping strategies in general. Among both males and females, slips were associated with more guilt. Lower perceived control was associated with slips in males, but not females. Positive coping strategies

were more frequently used by subjects and were associated with positive exercise outcomes at 3-month follow-up. Support for the AVE component of the RPM was found in that slips were associated with AVE variables, and baseline guilt and perceived control among males were associated with outcomes at 3 month.

In summary, RPM exercise studies thus far provide some support for an association between coping response repertoire and exercise adherence and relapse, support for the affect and control components of the abstinence violation effect, and for the efficacy of relapse prevention strategies in promoting exercise adherence. Recent research highlights potential gender differences in processes of exercise maintenance and relapse.

Mindfulness

Mindfulness is an emerging construct underlying recent clinical interventions to improve mental and physical health (Baer, 2003). In clinical application, mindfulness has been used to increase awareness of cognitive and affective processes, with greater awareness facilitating greater perceived control and an enhanced repertoire of coping responses to psychological distress. Bishop and colleagues (Bishop, Lau, Shapiro, Anderson, Carmody, et al., 2004) have proposed an operational definition of mindfulness, as follows:

> We propose a two-component model of mindfulness. The first component involves the self-regulation of attention so that it is maintained on immediate experience, thereby allowing for increased recognition of mental events in the present moment. The second component involves adopting a particular

> orientation toward one's experiences in the present moment, an orientation that is characterized by curiosity, openness, and acceptance. (pg. 232)

These components are reflected in Kabat-Zinn's characterization of mindfulness as, "a process of bringing a certain quality of attention to moment-to-moment experience (pg. 233)."

In the proposed operational definition, attention is oriented towards immediate experience thereby facilitating the observation of mental events as they occur (Bishop, et al., 2004). The second aspect of the operational definition of mindfulness, an orientation of acceptance and openness toward immediate experience, reflects a stance in which the present moment is experienced with openness, curiosity and acceptance. These authors note that, "mindfulness practices are thought to be associated with improvements in cognitive inhibition, particularly at the level of stimulus selection" and that, "mindfulness can be defined, in part, as the self-regulation of attention, which involves sustained attention, attention switching and the inhibition of elaborative processing (pg. 233)." Noting that metacognitive processes are implicit in their proposed operational definition, these authors suggest that mindfulness is a metacognitive skill requiring both, "control of cognitive processes (i.e., attention self-regulation) and monitoring the stream of consciousness (pg. 233)."

The concept of mindfulness as a metacognitive process echoes the position of Teasdale and colleagues (Teasdale, 1999) who consider mindfulness to be a metacognitive process which facilitates metacognitive insight, an "experience of thoughts as events in the field of awareness, rather than as direct readouts on reality (pg. 146)." This premise provided the foundation for the development of Mindfulness-Based

Cognitive Therapy (MBCT) to reduce depressive relapse in previously depressed patients (Segal, Williams, & Teasdale, 2002). In this intervention, mindfulness has been used successfully to explore negative automatic thoughts and cognitions and reduce depressive relapse (Ma & Teasdale, 2004).

Mindfulness-Based Stress Reduction (Kabat-Zinn, 1990), the program from which MBCT was developed, was designed in part to provide chronic illness patients with skills for responding to stressful events. In his characterization of the role of mindfulness and stress reactivity, Kabat-Zinn suggests that mindfulness moderates the process between stressful events and coping strategies, such that maladaptive coping is lessened with increasing mindfulness. Modulation of stress reactivity is proposed as a potential mechanism by which positive health outcomes observed in patients completing MBSR programs are explained. Empirical studies have shown relationships between mindfulness and physical well-being (Brown & Ryan, 2003), and recent studies have begun to identify potential physiological mechanisms of action (Carlson, Speca, Patel, & Goodey, 2003; Davidson, Kabat-Zinn, Schumacher, Rosenkranz, Muller, et al., 2003).

Although the literature regarding acceptance-based interventions is replete with mindfulness-based intervention studies, a theoretical discussion regarding the mechanisms of action of mindfulness interventions was absent from the literature until recently. Shapiro and colleagues (Shapiro, Carlson, Astin, & Freedman, 2006) proposed a model of mindfulness and associated mechanisms of action. These authors suggest that the following three axioms are fundamental aspects of mindfulness: intention, attention, and attitude (IAA). These axioms are associated with mindfulness practice in that the practitioner engages in purposeful attention with a specific attitude and intention. These

processes occur simultaneously and IAA is asserted to account for "a large amount of the variance in the transformations that are observed in mindfulness practice (pg. 377)." The authors further assert that, "intentionally (I) attending (A) with openness and non-judgmentalness (A) leads to a significant shift in perspective, which we have termed reperceiving (pg.377)." Reperceiving is, "the capacity to dispassionately observe or witness the contents of one's consciousness (pg. 381)" and is the process that enhances mindfulness. Reperceiving involves more direct change mechanisms including: "(1) self-regulation, (2) values clarification, (3) cognitive, emotional, and behavioral flexibility, and (4) exposure (pg. 377)."

The self-regulation mechanism of mindfulness allows one to step back from distressing internal states, facilitating less automaticity and greater flexibility in response options. "Through consciously (intention) bringing awareness (attention) and acceptance (attitude) to experience in the present moment, we will be better able to use a wider, more adaptive range of coping skills (pg. 380)."

Reperceiving facilitates greater clarity and integrity regarding personal values. As mindfulness increases and automaticity decreases, "we become able to reflectively choose what has been previously reflexively adopted or conditioned. The literature suggests that automatic processing often limits considerations of options that would be more congruent with needs and values (Brown & Ryan, 2003; Ryan, Kuhl, & Deci, 1997 as cited in Shapiro, et al., 2006, pg. 380)."

Reperceiving also contributes to greater cognitive, emotional, and behavioral flexibility. The RPM and associated empirical evidence suggests that it is the limitation in response options to situational factors and internal states that are predictive of future

slips, lapses and relapse. Shapiro and colleagues (Shapiro, et al., 2006) assert that, "Reperceiving enables the development of this capacity to observe our ever-changing inner experience and thereby see more clearly our mental-emotional content, which in turn fosters greater cognitive-behavioral flexibility and less automaticity or reactivity (pg. 381)."

Finally, reperceiving facilitates a greater capacity to tolerate exposure to distressing or previously avoided internal states. "Reperceiving - the capacity to dispassionately observe or witness the contents of one's consciousness - enables a person to experience even very strong emotions with greater objectivity and less reactivity. . . . .Through this direct exposure, one learns that his or her emotions, thoughts, or body sensations are not so overwhelming or frightening and phenomenologically that such emotions need not be feared or avoided and that they eventually pass away (Segal, Williams, & Teasdale, 2002 as cited in Shapiro, et al., 2006, pg. 381)."

The acceptance-based intervention literature includes numerous studies of mindfulness-based health interventions that typically focus on outcomes in chronically or acutely ill populations. However, the relationship of mindfulness to health-promoting behaviors in healthy adults has received very little, if any, attention in the literature.

Mindfulness and Relapse Prevention

Mindfulness has been integrated into several recent social-cognitive interventions for relapse prevention, including relapse prevention training for substance abuse (Marlatt, 2002) and depression (Segal et al., 2002). In developing the RPM, Marlatt recommended meditation as a way to achieve a balanced lifestyle (Marlatt, 2002), and specifically considered the role of mindfulness in relapse prevention for alcohol addiction (Marlatt,

1994). Marlatt (2002) notes that "urges are often conditioned responses triggered by cues and high-risk situations (pg. 47)," and that mindfulness facilitates "urge surfing", the ability to maintain balance and observe the rising and falling of urges without giving in to them (pg. 181, Marlatt, 1994). Consistent with the relapse prevention model, successful negotiation of urges and high-risk situations (effective coping response) predicts greater self-efficacy in high-risk situations.

With respect to response to lapse and relapse, Marlatt (2002) noted that, "Mindless addicts may be more vulnerable to relapse to the extent that they attribute a failure to change (e.g., to lapse despite a commitment to abstinence) to personal failure and weakness (i.e., the Abstinence Violation Effect). A mindful approach would include an appraisal of both negative and positive aspects of the addictive behavior . . . (pg. 177)." Marlatt proposes that mindfulness should play a critical role in preventing relapse by facilitating a "detached awareness of thoughts, without overidentifying with them or reacting to them in an automatic, habitual manner (pg. 47)." In RPM terms, the AVE is attenuated by mindfulness through modulation of global, stable and internal attributions as to the cause of the lapse, and decreased all-or-none thinking about abstinence/relapse (Marlatt, 1994). Decreased guilt and perceived loss of control, the primary "symptoms" of the AVE, follow from attenuated dysfunctional attributions and decreased all-or-none thinking.

Marlatt's discussion of the role of mindfulness in relapse from alcohol abstinence suggests that mindfulness may moderate the relationship between several constructs in the RPM. First, mindfulness should have an indirect effect on self-efficacy in high-risk situations by moderating the relationship between high-risk situations and coping

response. More mindful individuals should theoretically be more likely to have an effective coping response versus an ineffective coping response, thereby increasing their sense of self-efficacy in high-risk situations. Mindfulness should also have an indirect effect on relapse by moderating the relationship between lapse and the AVE. Theory suggests that more mindful individuals should have less all-or-none thinking and less guilt and perceived loss of control following a lapse.

The findings of a recent study of incarcerated substance abusers and a meditation-based intervention provide preliminary support for Marlatt's assertion that mindfulness has a role in maintaining abstinence. Participants in the meditation-based intervention used significantly less substances, including alcohol, marijuana and cocaine, and realized fewer negative consequences due to alcohol use at a 3 month post-intervention assessment (Bowen, Witkiewitz, Dillworth, Chawla, Simpson, et al., 2006). They also "reported significantly lower levels of psychiatric symptoms, more internal alcohol-related locus of control, and higher levels of optimism (Bowen, et al., 2006, pgs. 346-347)."

Mindfulness and Exercise

Interventions designed to promote adherence to PA are increasingly effective. Bock and colleagues conducted a highly efficacious intervention study to investigate predictors of exercise maintenance using a motivation-matched individually tailored PA intervention. They found that post-intervention improvements in adherence to CDC/ACSM guidelines were largely maintained for up to 12 months following the intervention. Citing the Bock study, Sallis (2001) notes that in spite of the fact that these interventions seem to be working, the mediators of change considered in the various

theoretical models are capturing only a small proportion of the variance explaining post-intervention outcomes. Accordingly, he asks the question, "If our interventions are not working through the mechanisms we propose, how are they working? (pg. 77)." Noting the small body of literature on this topic, Sallis emphasizes the need to investigate mediators of change in PA.

Among the strategies commonly employed in PA interventions are cognitive-behavioral techniques such as self-monitoring (keeping activity logs), reporting of activity to researchers, attending to and changing "self-talk", stimulus control strategies, and contingency management (King, 1994; Sallis & Owen, 1999). Self-regulatory and self-monitoring skills have been found to predict exercise participation (Marcus, et al., 1997). It could be argued that these strategies involve increased attention and awareness of behavioral and cognitive processes as they relate to exercise, and that increased awareness in the form of mindfulness could play a role in exercise adherence.

With respect to the RPM, it is implicit in the process of employing a coping response in a high-risk situation that there is an awareness of the presence of a high-risk situation. This awareness is followed by a choice between the coping strategies available to the exerciser. Certainly with respect to cognitive high-risk situations, such as negative mood, metacognitive processes involve observing cognitions and affect associated with the mood in order to respond effectively to the high-risk situation. This process tends to happen quickly and is largely automatic. This assertion is supported to some extent by an interpretation of the cognitive processes involved in smoking cessation, as discussed by Shiffman and colleagues (Shiffman, Read, Maltese, Rapkin, & Jarvik, 1985):

> If the smoker survives these tests, he or she is often faced with a problem in meta-coping - deciding what coping response to use. This involves evaluation of the situation and of one's coping repertoire and a match between the two. (Obviously, these processes are nearly instantaneous and largely implicit) (pg. 475).

It is reasonable to assume that the greater the ability to observe cognitions and affect, and their impact on behavior, the more effective one can be in responding to high-risk situations. In the case of psychological distress, mindfulness employed as a coping strategy has been associated with less anxiety and higher levels of efficacy in students endorsing anxiety symptoms (Clancy, 2004).

To date, mindfulness has been assessed in only one study of exercise behavior (Ulmer, Stetson, Beacham, Salmon, & Meyer, 2004). In a study of exercisers recruited from a local YMCA facility (N=88), mindfulness scores for this physically active sample were significantly higher than norms for the general population (p=.001), and level of mindfulness was found to predict self-efficacy for exercise (p=0.001), and guilt during dropout from exercise (p=.034).

Purpose of the proposed study

The rates of obesity and physical inactivity in the United States are escalating and US adults have difficulty maintaining beneficial levels of exercise. Although the interventions designed to increase PA are often effective, the mechanisms by which these interventions work are only partially understood. Thus, the introduction of novel behavioral change factors in the exercise literature is warranted. The author of the RPM notes the importance of mindfulness in relapse prevention interventions with substance abusers, particularly with respect to coping and attenuation of the AVE. However, the

role of mindfulness in the RPM has not been assessed in exercise, or other health promoting behaviors. The purpose of the proposed study was to assess the role of mindfulness in moderating the relationship between high-risk situations for exercise relapse and coping response, and between exercise lapse and AVE. Since the RPM is a longitudinal model reflecting the sequelae of responses to high-risk situations, and the current study is cross-sectional in nature, these relationships were assessed using relationships between variables that represent traits, tendencies, and behaviors as proxies for the situational and longitudinal constructs of the RPM.

It was hypothesized that mindfulness would be found to moderate the relationship between certain RPM variables as applied to exercise. Specifically, it was hypothesized that:

1. Mindfulness would significantly moderate the relationship between high-risk situation (i.e.-vulnerability to relapse) and coping response (Figure 3) such that, compared to more mindful participants, utilization of ineffective coping strategies (employing a "no-coping" response in RPM terminology) among less mindful participants would be greater at higher levels of relapse vulnerability.
2. Mindfulness would significantly moderate the relationship between slip frequency and the abstinence violation effect (Figure 4) in lapsers, such that level of AVE among less mindful participants would be greater at higher slip frequencies, while level of AVE in more mindful participants would not differ between high and low slip frequencies.

METHOD

Participants

Participants were adult community exercisers recruited from one of seven local YMCA facilities in Louisville, Kentucky and Southern Indiana. Study participants were screened at recruitment to assure that they were at the facility for purposes of exercise (e.g., as opposed to maintenance of the facility or other reasons), and were at least 21 years of age. No other exclusionary criteria were used.

Procedures

Participants were approached as they were entering or leaving the YMCA facility and asked if they would like to participate in research being conducted by the University of Louisville on the topic of exercise and health behaviors. After providing an overview of the study and assuring that the potential participant was at least 21 years of age, informed consent was obtained from all individuals expressing interest in the study. Individuals who expressed interest in the study, but could not stop to complete consent forms at the time of the interview were given a packet of questionnaires to take home with them, and were told that the review of informed consent form must accompany questionnaire completion and that the signed consent form must be returned with the completed questionnaire packet (a consent form copy for participant records was also

included in the packet). All participants were given a packet of questionnaires and asked to return them within a two-week period using the pre-stamped envelope provided.

Measures

As discussed above, the study was designed to reflect cross-sectional relationships between certain constructs of the RPM. Thus, the selected measures were chosen to reflect patterns of exercise behavior and associations with RPM constructs rather than the sequelae of high-risk situations as described in the dynamic Relapse Prevention theoretical Model. The measures of general tendencies utilized in the present study included both exercise specific measures and more general measures applying to disposition and trait. The selected measures and their associated RPM constructs are outlined in Table 2.

General Background Measures

Demographic and Background Information Questionnaire

Participants completed a brief demographic questionnaire assessing gender, age, ethnicity, years of education, income, primary relationship status, religious affiliation, number of persons in household, and occupation.

Baseline Physical Activity Status

Physical activity status was assessed using the short form of the International Physical Activity Questionnaire (IPAQ: Craig, Marshall, Sjostrom, Bauman, Booth, et al., 2003). The IPAQ is a nine-item questionnaire in which the respondent provides the number of days per week and minutes and hours per day spent in various activities over the previous one-week period. Activities assessed included time spent walking, time engaged in moderate or vigorous intensity activity, and sedentary activity. Previous research by Craig et al. found test-retest reliabilities for the English version of this

measure ranged from .66 to .88 for total physical activity. Test-retest percent agreements with the CDC/ACSM guidelines have been reported to range from 93% to 100%. Convergent validity was established by comparing the IPAQ short form to the long form with concurrent questionnaire administration. Spearman coefficients between measures were .76 for total physical activity and .89 for the categorical adherence criterion. Criterion validity was established by comparing short form energy expenditure estimates to data obtained from accelerometers worn by the participant over the course of the week in question. Accelerometers are considered the most valid and accurate assessment tool for measuring actual energy expenditure in the absence of impractical laboratory techniques. Spearman's coefficients for the short form of the IPAQ compared to accelerometers ranged from .46 to .81, suggesting fair to good validity of the measure.

Relapse Prevention Model Measures

High Risk Situations

This construct was measured using the Reasons for Relapse Scale (RRS), which is a 24-item five-point Likert scale measure (Rose, 1994). Respondents were asked to indicate, for individuals who stopped exercising regularly for a period of one week or more in the past 6 months, the extent to which each of 24 items characterized their reason for drop-out from exercise. As a cross-sectional measure of the "High Risk Situation" component of the RPM, the RRS assesses vulnerability to relapse, with higher scores reflecting endorsement of a greater number of reasons for dropping out of exercise. The scale, as developed by Rose, was reduced to 12 items based upon factor analysis and consists of three subscales: personal reasons; situational reasons; and injury reasons. In a sample of university students and community exercisers recruited from a fitness club,

the RRS demonstrated good to excellent internal consistency across the scale as a whole (alpha=.93), and for individual subscales (personal reasons alpha=.93; situational reasons alpha=.83; and injury reasons alpha=.66). RRS subscales were also found to correlate in the theoretically anticipated direction with other measures commonly associated with exercise adherence and drop-out including, cons of exercise, temptations to skip exercise, demoralization, powerlessness, negative affect, relapse frequency, exercise self-efficacy, emotional benefits of exercise, positive affect, and exercise level (Rose, 1994).

Coping Response

Due to the absence of a well-validated exercise-specific coping measure in the literature, three measures of exercise-related coping were assessed for use in the study. Coping has typically been measured in behavioral health research using a survey completed in interview format in which the respondent is asked to generate as many coping responses as possible to high-risk situation vignettes. The number of coping strategies generated for the situation is then totaled and assessed for association with outcome. This approach to assessment of coping response has been used in other RPM studies of exercise (Simkin & Gross, 1994), alcohol use (Breslin, Sobell, Sobell, Sdao-Jarvie, & Sagorsky, 1996) and dieting (Drapkin, et al., 1995), and was associated with outcomes.

In the current study, the "Coping Response" construct of the RPM was assessed using measures that reflected the number and type of coping strategies employed in response to hypothetical high risk situations for exercise drop-out. The Exercise Coping Task (ECT) used by Simkin and Gross (1994) in an interview format was converted to a written self-report version and was used in the current study to assess the number of

coping strategies employed. Respondents were given a ½ page of writing space to provide "as many different solutions as you can to each situation using several brief responses" for each of 10 high-risk situation vignettes. At the end of each written vignette, participants were asked "How would you respond to this situation in order to keep exercising?"

The Exercise Processes of Change (EPOC) Questionnaire was used as a second measure of coping response specific to exercise high-risk situations (Marcus et al., 1992a). The measure was developed to assess cognitive and behavioral processes of change used by sedentary individuals to change behavior, and was derived from the Transtheoretical Model Processes of Change questionnaire (POC) which assesses the processes by which behavior change occurs (Prochaska, Velicer, DiClimente, & Fava, 1988). However, in a study of lapse and relapse in individuals treated for heroin use, the POC (adapted for drug use) was used as a measure of coping response as conceptualized in the Relapse Prevention Model (Gossop, Stewart, Brown, & Marsden, 2002). In fact, many of the POC (adapted for smoking) items reflect coping strategies employed to negotiate high risk situations including items such as, "I remove thing from my home that remind me of smoking", "I reward myself when I don't smoke", and "When I am tempted to smoke, I think of something else." Similarly, many EPOC items reflect coping in response to or anticipation of exercise high-risk situations, such as, "I use a calendar to schedule my exercise time" and "I keep a set of exercise clothes conveniently located so I can exercise whenever I get the time".

The EPOC is a 40-item inventory that assesses the frequency of both behavioral and cognitive strategies employed in the process of behavior change. A five-point Likert

scale is employed to obtain EPOC responses ranging from 1 (never) to 5 (repeatedly). Respondents are asked to rate the level of frequency with which the indicated experiences occurred during the past month. Reliability of the EPOC was established in a sample of college students and fitness club members (*N*=270), and internal consistencies for EPOC subscales ranged from .68 for the Social Liberation subscale to .89 for the Counter Conditioning subscale. The EPOC was used as an outcome measure in a physical activity intervention study of sedentary adults. Both cognitive and behavioral processes of change were associated with membership in more active post-intervention groups, and behavioral processes were associated with exercise adherence (meeting the CDC/ACM guidelines) at follow-up (Bock, et al., 2001).

The Brief COPE scale was added to the protocol as a third measure of coping. The Brief COPE was used to assess dispositional coping strategies (Carver, Scheier, & Weintraub, 1989) and is composed of 28 four-point Likert scale items with 14 subscales reflecting: active coping; planning; positive reframing; acceptance; humor; religion; using emotional support; using instrumental support; self-distraction; denial; venting; substance use; behavioral disengagement; and self-blame. Respondents are asked to indicate the extent to which they have utilized the indicated coping strategies to deal with stress using a four-point Likert scale ranging from 1 (I haven't been doing this at all) to 4 (I have been doing this a lot). Examples of Brief COPE items are, "I've been getting emotional support from others"; "I've been refusing to believe that it has happened", and "I've been turning to work or other activities to take my mind off things." The factor structure of the Brief COPE, established using confirmatory factor analysis, is largely consistent with the full COPE measure from which it was derived. Subscale internal

consistencies range from .50 to .90. Reliability of the brief COPE was also demonstrated in a sample of HIV/AIDS patients, with all subscale reliabilities in the acceptable range, with the exception of the self-distraction subscale (Vosvick, Koopman, Gore-Felton, Thoreson, Krumboltz, et al., 2003). The brief COPE was also found to predict social functioning and energy level (Vosvick, et al., 2003).

Outcome Expectancies

The outcome expectancy construct was assessed using the Outcome Expectancies for Exercise scale (OEE) (Resnick & Jenkins, 2000). The OEE is a nine-item measure in which the respondent indicates their level of agreement with statements about exercise, which actually reflect the perceived consequences of exercise, using a 5-point Likert scale. Item ratings range from 1 (strongly agree) to 5 (strongly disagree). Examples of OEE items are, "Makes me more alert", and "Helps to strengthen my bones". Internal consistency of the OEE was established in a sample of older adults residing in a retirement community (alpha=0.89, N=175). In a separate study of older adults, also residing in a retirement community, reliability was established using R^2 values from a structural equation model, and validity was established using confirmatory factor analysis and model fit indices. R^2 values for the OEE ranged from .42 to .77, and confirmatory factor analysis revealed a reasonable fit of the model to the data. The nine items composing the OEE explained 83% of the variance in outcome expectations. The OEE is being used in an ongoing longitudinal assessment of the effects of an 18-month telephone-administered physical activity adoption and maintenance counseling program as a baseline moderator that may predispose participants to greater success in program objectives (King, Friedman, Marcus, Castro, Forsyth, et al., 2002).

Abstinence Violation Effect

Guilt

Dispositional guilt, or guilt proneness, was assessed using the Harder Personal Feelings Questionnaire-2 (PFQ-2: Harder, & Zalma, 1990). The PFQ-2 is a 22-item self-report adjective checklist in which respondents were asked to rate how common each feeling is for them. Items were rated on a scale from 0 (means that you never experience the feeling) to 4 (you experience the feeling continuously or almost continuously). The PFQ-2 consists of two subscales of guilt and shame. Guilt subscale item descriptors are, "regret" and "feeling you deserve criticism for what you did", and shame subscale descriptors are, "embarrassment" and "feeling stupid". Reliability of the PFQ-2 was initially established in a sample of college students (*N*=63). The PFQ-2 demonstrated acceptable internal consistencies and test-retest reliabilities for both the guilt (alpha=.72, *r*=.85) and shame (alpha=.78, r=.91) subscales, and was found to be associated in the intuitive direction with depression, self-derogation, social anxiety and public self-consciousness. In a subsequent validation study of college students (*N*=41), the PFQ-2 was positively correlated with personality constructs such as neuroticism, and negatively correlated with attachment, extraversion, and openness.

Guilt was also assessed using a single visual analog scale item with a 0-10 range in which the subject was asked to "Place an X on the line corresponding to how guilty you felt about your exercise during the time you dropped out". Responses were scored in 1/4 units.

Perceived Control and Attributions regarding Exercise Performance

Perceived control and exercise-performance attributions were measured using the Revised Causal Dimension Scale (CDSII: McAuley, Duncan, & Russell, 1992), a

measure of causal attributions regarding the perceived cause for an event provided by the respondent at the top of the questionnaire. The exercise version of the measure includes the following statement at the top of the page, "Please list the main reason why you have been successful or unsuccessful in meeting your exercise goal(s)." A Likert scale from 9 to 1 is bounded on both ends by statements completing the following question, "Is the cause(s) something . . .". Possible completion statements include "that reflects an aspect of yourself" (9) or "reflects an aspect of the situation" (1). The CDSII has an established four-factor structure with subscales including: locus of causality; stability; personal control; and external control. Causal attributions for exercise success or lack of success derived from the CDSII reveal attributions on the internal-external, stable-temporary, and two subscales reflecting locus of control (personal and external) dimensions. The four-factor model of the CDSII was found to provide an excellent fit to the observed data in a sample of undergraduate university students (*N*=144), and factor loadings explained 31% to 67% of the variance in individual responses (McAuley, et al., 1992). In a sample of 80 middle-aged sedentary adults participating in a structured exercise program, reported internal consistencies for the CDSII were found to be adequate, as follows: locus of causality (alpha = .70); stability (alpha = .75); personal control (alpha = .92); and external control (alpha = .82) (McAuley, 1991). Frequency of exercise was found to be predicted by more internal, personally controllable, and stable attributions for exercise progress.

Perceived control was also assessed using a single visual analog scale item with a 0-10 range in which the subject was asked to "Place an X on the line corresponding to how much control you felt over your exercise during the time you were dropped out". Responses were scored in ¼ units.

A third measure of perceived control employed in the study was the Competence subscale of the Demoralization Scale for Exercise (DSE). The DSE is a 12-item measure in which respondents are asked to indicate their level of endorsement with various exercise related statements reflecting confusion and demoralization regarding exercise (Rose, 1994). Items are rated on a five-point Likert scale ranging from 1 (never) to 5 (always). The DSE is composed of two subscales including subjective competence ("When faced with a dilemma about exercising, I usually know what to do") and distress ("I often fail to meet my own expectations regarding exercise"). The face validity of items and the factor structure of the measure suggest that it may tap two of the critical constructs underlying the AVE, perceived control and affective distress about exercise. In a sample of university students and community exercisers recruited from a fitness club (*N*=270), the DSE was found to be positively correlated with high risk situations for exercise relapse as measured by the Reasons for Relapse Questionnaire, and accounted for a high proportion of the variance in exercise relapse frequency (Rose, 1994). The Demoralization Scale, from which the DSE was derived, has demonstrated adequate internal consistencies for each of the subscales: subjective competence (alpha=.84); and distress (alpha = .77) (Harlow, Mitchell, & Fitts, 1999).

Moderator Construct Measure

Mindfulness

This construct was measured using the Mindful Attention and Awareness Scale (MAAS: Brown, & Ryan, 2003), which is a 15-item self-report measure of "individual differences in the frequency of mindful states over time (pg. 824)." The MAAS (Brown & Ryan, 2003) was developed to measure trait or dispositional mindfulness rather than

state mindfulness, and the studies cited below are all included in the paper establishing the validity of the measure. In a sample of college students, the MAAS demonstrated high internal validity (alpha=.87) with a single latent variable, and high test-retest reliability (r=.81, p<.0001). In one of several validation studies, the MAAS demonstrated good convergent and discriminant validity. Mindfulness was associated in the theorized direction with: another measure of mindfulness; with various personality variables such as openness to experience, novelty seeking, and neuroticism; with dispositional constructs such as optimism, self-esteem; with emotional disturbance and affective constructs such as depression, anxiety, and affect; and with physical well-being as measured by physical symptoms and medical visits. Consistent with theoretical conceptualizations of mindfulness, MAAS scores in a sample of Zen Buddhism meditation practitioners were significantly higher than a comparison sample of adults. In another study using ecological momentary assessment with adults, the MAAS demonstrated convergence with measures of self-regulated behavior and divergence with frequency and intensity of unpleasant affect. Finally, in an uncontrolled intervention study of breast and prostate cancer patients, higher post-Mindfulness-Based Stress Reduction intervention MAAS scores predicted lower mood disturbance and stress.

Research Design and Analyses

Data Cleaning and Screening

The data were screened and evaluated in accordance with recommendations by Tabachnick and Fiddell (2001). These authors recommend deletion of missing cases when there are no patterns observed in the distribution of missing data. Since there were no patterns observed and the number of subjects with valid data was adequate for all

analyses, subjects with missing data were dropped from the analysis for which the data was missing. The default deletion setting for SPSS (i.e.-pairwise deletion for correlations, etc.) was utilized for all analyses unless explicitly stated below.

Data was inspected for input accuracy by identifying out-of-range values, univariate outliers, and implausible means and standard deviations. Once data entry errors were identified and corrected, the remaining outliers were considered to be reflective of the actual YMCA population. Thus, efforts were made to retain all data to the extent possible when addressing non-normal distributions. The approach recommended by Tabachnick and Fiddell (2001) to retain outliers that are believed to be part of the target population is to reduce the impact of extreme outliers by changing the value of an outlier to make it less deviant from the remainder of the distribution. This was accomplished by assigning "the outlying case(s) a raw score on the offending variable that is one unit larger (or smaller) than the next most extreme score in the distribution (pg. 71, Tabachnick & Fiddell, 2001)." This approach was adopted for distributions with skewness statistics exceeding +/-1 due to the presence of extreme outliers. Other distributions were moderately positively skewed and were transformed to reduce skewness by calculating the square root of the variable. One of these two approaches was effective for reducing skewness of all variables with the exception of the Brief Cope Denial subscale that retained a skewness statistic of 2.43, and the item assessing the number of times the participant missed one week of exercise over the previous year. This variable had a bimodal distribution and after extreme outliers were reduced, the skewness statistic was 1.42.

Multivariate outliers were identified by inspection of the Mahalanobis distance. Distances with chi-square values exceeding the value for the appropriate degrees of freedom ($p<.001$) were considered to be a multivariate outliers. Multivariate outliers were evaluated for each of the two Hypotheses independently. Two participants were found to be multivariate outliers across all possible Hypothesis 1 analyses. Thus, Hypothesis 1 analyses were conducted without these cases. No multivariate outliers were identified for Hypothesis 2. Multicollinearity between variables in each of the analyses was assessed by inspection of the Variance Inflation Factor (VIF) and Tolerance for each variable. Multicollinearity was not present among variables for either of the two Hypotheses.

Construct Definitions

Physical Activity Status Defined

For this study, the total time spent in each three categories (Vigorous Intensity Activity, Moderate Intensity Activity, Walking) was weighted in accordance with energy expenditure references (METs, metabolic equivalents-a multiple of resting metabolic rate) as outlined in the 2000 compendium of physical activities (Ainsworth, Haskell, & Whitt, 2000), in accordance with the protocol for use of the IPAQ (Craig, et al., 2003). Vigorous intensity MET-minutes per week was calculated by multiplying the average MET score of 8 for vigorous activities by the product of vigorous minutes/day and vigorous intensity days per week for each participant. Moderate intensity MET-minutes per week was calculated by multiplying the average MET score of 4 for moderate activities by the product of moderate minutes/day and moderate intensity days per week. Walking MET-minutes per week was calculated by multiplying the average MET score

of 3.3 for walking by the product of walking minutes/day and walking days per week. In accordance with the IPAQ scoring guidance, all Walking, Moderate and Vigorous time variables exceeding 4 hours or 240 minutes were truncated (recoded) to be equal to 240 minutes. This rule permits a maximum of 28 hours of activity in a week to be reported for each category of physical activity. Participants' level of physical activity was then classified as High, Moderate or Low using the IPAQ scoring protocol criteria as outlined in Table 3 (IPAQ: Craig, et al., 2003).

Exercise Maintenance Variables Defined

Adherence

Based upon self-reported physical activity on the IPAQ for the "last 7 days", adherence to CDC/ACSM physical activity guidelines was determined using total number of minutes in moderate to vigorous activity per week. Participants were considered to be adherent to CDC/ACSM guidelines if they engaged in "moderate intensity physical activities for at least 30 minutes on 5 or more days of the week, or if they engaged in vigorous-intensity physical activity for 3 or more days per week for 20 or more minutes per occasion. (Department of Health and Human Services, 2000 and CDC/ACSM, 1995 as cited at http://www.cdc.gov/ nccdphp/dnpa/physical/recommendations/index.htm).

Slips, Lapses and Relapse

For purposes of this study, an exercise omission (slip) was assessed as a continuous variable reflecting the difference between self-reported planned exercise sessions per week over previous month and the number of self-reported actual exercise sessions per week over the previous month. Lapse and relapse were assessed as dichotomous (yes/no) categorical variables reflecting endorsement of a specific period of

continuous days of missed exercise over the previous one year period. Based upon exercisers' perceptions of lapse in previous research (Stetson, et al., 2004), lapse was defined as a period of 2 weeks without exercise. Relapse was defined as a period of 3 continuous months of missed exercise after having consistently exercised for a period of 6 months or longer as consistent with previous research (Sallis, et al., 1990).

Exercise Maintenance

Five items were selected from the exercise variables employed in the study to compare participants on the various RPM constructs as a function of exercise maintenance, including: *Slips* (continuous variable reflecting frequency), *Lapse* (categorical variable representing lapse in previous year-no/yes), *Relapse* (categorical variable representing relapse in previous year-no/yes), *Exercise Status* (categorical variable representing perceived exercise status-non-regular exerciser/regular exerciser), and *Adherence to CDC/ACSM Guidelines* (categorical variable representing adherence calculated from self-reported retrospective exercise frequency-nonadherent/adherent). These items were selected based upon their empirically established relationship with exercise maintenance in the physical activity literature, and are discussed collectively throughout the remainder of the document as "Exercise Maintenance Variables".

Development and Scoring of RPM Measures

Vulnerability to Relapse

As noted above, the development study for the Reasons for Relapse Scale (Rose, 1994) revealed three subscales reflecting personal reasons, situational reasons, and injury reasons. Since the present study is designed to assess vulnerability to relapse, and there is no empirical basis for predicting differential relationships between mindfulness and the

various subscales, the three subscales were combined to create a total score for the Reasons for Relapse measure, and this total was used to reflect vulnerability to relapse in all analyses.

Coping

As noted above, three measures of coping were employed in the study due to the absence of a validated exercise-coping measure. Each coping measure was evaluated for its' association with the exercise maintenance and other exercise measures. As discussed in the Results section, the coping measure that demonstrated the strongest evidence for convergent validity with exercise maintenance variables and other exercise measures was selected for evaluation of Hypothesis 1.

Exercise Coping Task

Scores for the Exercise Coping Task (ECT) were derived by tallying the total number of responses to each of the 10 vignettes, and then summing the totals for the individual items. The total score was then used as the ECT score for each participant. Some responses provided by participants were not actual coping strategies. For example, in response to the following vignette, "After you arrive at the gym, you learn that the aerobics class you usually go to has been cancelled for the day. How would you respond to this situation in order to keep exercising?", some participants stated that they do not participate in aerobics classes, suggesting that the situation is not applicable to them. Two research assistants who assisted with data entry were trained on differentiating responsive and nonresponsive answers to the ECT. All coders were then asked to code the same packet of responses from a random sample of 10 participants**.** Initial inter-rater

agreement was very high (κ=.88). Coders were then provided with additional training to clarify inconsistencies across coders prior to beginning data entry.

Exercise Processes of Change

Consistent with the approach adopted by Gossop and colleagues (Gossop, et al, 2002), specific EPOC items reflecting coping response were selected from the measure for use as the coping response variable. Principal components analysis was used to assess the internal consistency of the factor developed from the EPOC. Scores for the individual items comprising the factor were totaled to create a total score for the exercise coping factor.

Based upon their face validity, items were chosen from the Exercise Processes of Change measure to assess coping response. These items were subjected to principal components analysis with Oblique rotation to extract an underlying exercise coping factor. Three components with initial eigenvalues exceeding 1 were retained in the solution, and this was consistent with the number of factors to be extracted based upon inspection of the scree plot. After rotation, the first factor accounted for 35.82% of the variance, the second factor accounted for 16.42%, and the third factor accounted for 14.59%. Table 4 displays the selected items and factor loadings for the rotated factors with loadings less than .40 omitted to improve clarity. All items loaded on one of the three factors, and only one of the three factors contains more than two items. Factors comprised of less than three items were not used. Thus, the five-item factor was retained as the exercise coping measure based upon both face validity and the limited number of items in the other factors.

Brief COPE for Exercise

The instructions for the original Brief COPE measure were modified to address obstacles to exercise, however, the COPE items themselves were not changed. In the current study, the Brief COPE subscales were selected for use in analyses based upon their empirically established association with exercise in previous research and/or theoretically or empirically based relationship with mindfulness. The internal consistency for the selected subscales is summarized in Table 5. The following subscales were selected for use in subsequent analyses based upon their demonstrated acceptable internal consistencies (>.70): Instrumental Support Coping; Planning Coping; Self-Blame Coping; and Emotional Support Coping.

Abstinence Violation Effect

Abstinence Violation Effect variables were created in accordance with AVE theory using the product of several AVE associated variables. Table 6 outlines the 4 AVE variables and their components. AVE1 was constructed to include the components described by Marlatt as characterizing the AVE, including high internal and stable attributions, low personal control, and high guilt/distress. As consistent with RPM theory, high scores on AVE1 are reflective of a high level of internal and stable causal attributions, a low level of personal control and a high level of associated exercise guilt/distress. The abstinence violation effect is often discussed in terms of perceived control and guilt/distress alone. Thus, AVE2 and AVE3 constructs were created by breaking the components of AVE1 into their respective subcomponents (AVE2=high stable and high internal attributions, and AVE3=low personal control and guilt/high distress).

Statistical Approach

Statistical Analyses for Description and Comparison

T-tests were used to compare means across groups, Pearson correlations were used assess associations between continuous variables, and Chi-Square analyses were used to examine relationships between discrete variables. Test statistics with an associated alpha level of .05 or less were regarded as statistically significant.

Statistical Analyses for Hypothesis Testing

In accordance with the approach outlined by Frazier, Tix, and Barron (2004) for testing moderator effects, hierarchical linear regression was used to assess mindfulness as a moderator in the Relapse Prevention Model for exercise. As recommended by Aiken and West (1991), continuous predictor and control variables were centered (standardized) for use in regression analyses. Based upon their associations with mindfulness or relevant exercise variables, demographic characteristics were included in regression analyses as control variables as appropriate. Control variables were entered in the first block, predictor and moderator variables, in the second block, and the interaction between mindfulness and the predictor variable (product term) was entered in the third block. The effects of the predictor and moderator variables were interpreted and the change in variance associated with the addition of the interaction term in the last block was used to evaluate the statistical significance of mindfulness as a moderator. Test statistics with an associated alpha level of .05 or less were regarded as statistically significant.

Probing of Significant Interaction Effects

Moderator effects were plotted to explore the form of the effect of mindfulness as a potential moderator. The statistical significance of the slopes of the simple regression lines were tested at values representing 1 standard deviation above and below the mean of the moderator. In accordance with procedures outlined by Aiken and West (1991), regression lines for high and low mindfulness participants were obtained by running two additional hierarchical linear regression analyses identical to the original analyses, excepting the substitution of high (plus 1 standard deviation above the MAAS mean) and low (minus 1 standard deviation below the MAAS mean) values for the MAAS.

Power Analyses

Based upon the power tables constructed by Cohen (1992), a minimum of 107 subjects would be needed to detect a medium effect size at a significance level of .05 using multiple regression with a total of 8 independent variables (including 5 control variables). The number of participants providing valid data exceeded 107 for all Hypothesis 1 analyses. Thus, the study was adequately powered to detect a medium effect size with 95% confidence for evaluation of Hypothesis 1. However, Hypothesis 2 analyses were conducted with data from 65 to 70 lapsers. Thus, these analyses were somewhat underpowered to detect a medium effect size at a significance level of $p<.05$, but adequately powered to detect a large effect size at both the $p<.05$ and $p<.01$ levels.

RESULTS

Response Rates

Of the 450 questionnaire packets distributed, 226 were completed and returned for an overall response rate of 50.22%. Response rates for individual sites ranged from 41.67% (*n*=5) for the Chestnut Street YMCA to 63.89% (*n*=25) for the Southwest YMCA.

Completion Rates for Exercise and Mindfulness Measures

Table 7 is a summary of responses to the various exercise measures employed in the study. Participants responded to measures at rates ranging from 81 to 95.8%. With the exception of two measures (the Reasons for Relapse Scale and the Causal Dimension Scale for Exercise), participants responded to all measures at rates equal to or exceeding 89%. Since the Reasons for Relapse Scale applied to individuals who "stopped exercising regularly . . . for a period of one week or more in the past 6 months", participants who endorsed having missed one week of exercise over the previous one-year period were selected, and the response rate was calculated on these subjects. This yielded a response rate of 82.2%. Similarly, the item assessing "Guilt while dropped out of exercise" is specific to participants who have "dropped out of exercise at least once". Participants who endorsed having dropped out of exercise at some time in the past were

selected, and the response rate for the "guilt while dropped out" item was calculated from these participants. This yielded a response rate of 95.8%.

Demographics

The demographic characteristics of participants by site are summarized in Table 8. As anticipated, participants differed across sites on age, $F(6,213) = 6.071$, $p<.001$, and ethnicity, $\chi^2(18, N=224) = 51.86$, $p=<.001$. Table 9 summarizes the combined sample in terms of demographic characteristics. All study analyses were based on the pooled set of participants from all sites. Participants were largely middle-aged (*M* age=49.96, *SD*=14.73), female (63.3%), Caucasian (85.5%), employed (64.2%), had no children living at home (61.6%) and had household incomes exceeding $60,000 (66.6%).

Table 10 summarizes demographic characteristics of the sample as compared to other relevant populations (US Census Bureau, http://quickfacts.census.gov/qfd/states/21000.html; Sallis, Hovell, Hofstetter, Faucher, Elder, et al., 1989). As compared to regional and national samples, this sample of YMCA exercisers in the Louisville Metropolitan is overrepresented by females. Participants in this sample are also more educated and have higher household incomes. African Americans are underrepresented relative to the recruitment area, but are represented at similar rates as the US Census 2000 sample.

Health Status

Table 11 summarizes participants in terms of health characteristics. Most participants rated their present health condition as either good or excellent (87.6%). Most participants in this sample were non-smokers (94.7%), in contrast with the 30.8% rate of current smoking among Kentuckians (Hughes, McCracken, Roberts, Mokdad, Balarami,

et al., 2006). Almost half the sample (48.5%) endorsed current pain. The mean Body Mass Index (BMI) for the sample was in the overweight range (*M* BMI=26.62, *SD*=5.73), with 19% of the sample falling into the obese range.

Table 12 summarizes participants in terms of chronic health conditions. Most participants endorsed having some type of chronic health condition (66.4%), and about one-quarter of the sample indicated that their health conditions affected their physical activity level (25.2%). Although chronic disease can impact the initiation and maintenance of physical activity, the intent of the present study was to obtain a heterogeneous sample that would be representative of the average adult exerciser who attempts to initiate and maintain exercise. Thus, the heterogeneity of participants is considered to be a desirable attribute of the current sample. Rates of endorsement for specific chronic health conditions in this sample are generally consistent with rates of chronic disease for Kentuckians (see Discussion), and divergence from the norms for chronic disease prevalence in a favorable direction is believed to reflect the physical activity status of this sample relative to norms for the commonwealth of Kentucky. Thus, participants were not excluded from the study based upon chronic disease status.

Physical Activity Characteristics

Participants' physical activity characteristics are summarized in Table 13. Based upon self-reported physical activity on the IPAQ for the "last 7 days", 78.2% of participants were adherent to CDC/ACSM physical activity guidelines. More than half of participants (67.4%) characterized themselves as being physically active at a greater than average level. Generally speaking, participants considered themselves to be regular

exercisers (84.5%), had exercised regularly for the past year (71.7%), and had missed one full week of exercise in the previous year (78%).

Table 14 summarizes the physical activity characteristics of the sample as compared to other relevant populations (Hughes et al., 2004; Sallis et al., 1989). Relative to other regional and national community samples, participants in this sample of YMCA exercisers are considerably more adherent to physical activity guidelines and endorse more frequent exercise sessions per week.

Gender Differences

Some gender differences were observed across exercise measures and exercise maintenance variables. As noted in Table 7, women reported greater use of emotional support coping, $t(203) = -2.10$, $p=.04$ (two-tailed), more guilt while dropped out of exercise $t(144) = -2.32$, $p=.02$ (two-tailed), and scored higher on the Exercise Processes of Change Coping measure $t(198) = -2.65$, $p<.01$ (two-tailed). Women also endorsed greater slip frequency $t(215) = -2.25$, $p<.05$ (two-tailed).

Ethnic Differences

Differences between the 2 ethnic groups comprising the majority of the sample (African Americans and Caucasians) were assessed. Relative to Caucasians, African Americans had significantly higher Body Mass Indexes, t (216) = -4.94, p<.001, endorsed significantly fewer days per week of exercise over the previous month, t (215) = 2.20, p=.03 (two-tailed), significantly greater exercise omissions (slips), t (215) = -2.58, p=.01 (two tailed), and greater use of planning coping, t (201) = -3.37, p=.001 (two tailed). Caucasians and African Americans did not differ on categorical exercise maintenance variables (i.e, lapse, relapse, regular exercise, and adherence).

Socioeconomic Status Differences

Participants were assessed for differences based upon income and education. Relative to participants with greater income, participants with household incomes of less than $60,000 had higher Body Mass Indexes, t (204) = 3.56, p<.001 (two tailed), endorsed less exercise competence, t (191) = -2.41, p=.02 (two tailed), and less guilt while dropped out, t (138) = -2.33, p=.02 (two tailed). Participants with less than 13 years of education endorse more days per week of exercise over past month, t (219) = 2.34, p=.02 (two tailed), greater use of planning coping, t (204) = -3.46, p=.001 (two tailed) and self-blame coping, t (204) = -2.03, p=.04 (two tailed), less exercise distress, t (203) = -2.05, p=.04 (two tailed), less exercise competence, t (204) = -2.85, p=.005 (two tailed), more control while dropped out, t (143) = 2.79, p=.006 (two tailed), less guilt while dropped out, t (145) = -2.35, p=.02 (two tailed), and greater mindfulness, t (199) = 2.20, p=.03 (two tailed). Exercise maintenance variables did not differ by income or educational level.

Vulnerability to Relapse

As discussed above, vulnerability to relapse as assessed by the Reasons for Relapse Scale was used in the current cross-sectional study as a proxy for the high-risk situations construct of the dynamic RPM model. High-risk situations are theorized to sequentially precede a coping response in the RPM. The internal consistency of the Reasons for Relapse scale combined measure (total of the three subscales) was acceptable (α=.74). Vulnerability to relapse was significantly associated with age (r=-.28, p<.01), but was not associated with gender or marital status. As displayed in Tables 15-19, the Reasons for Relapse total score was associated with exercise maintenance in the

theorized direction. Participants who were adherent to the CDC/ACSM guidelines and who reported being a regular exerciser endorsed significantly less vulnerability to relapse. Participants who lapsed (missed 2 weeks of exercise) over the previous year, who missed 3 weeks of exercise over previous year, and who had dropped out of exercise in the past endorsed significantly greater vulnerability to relapse. Vulnerability to relapse was also associated with exercise omissions (slips). Associations between relapse vulnerability and exercise maintenance variables are summarized in Table 31.

Coping

Coping was assessed to reflect the "coping response/no coping response" construct of the RPM. Both the Exercise Coping Task (α=.85) and the Exercise Processes of Change measure (α=.78) demonstrated acceptable internal consistencies. Internal consistencies for the Brief COPE subscales are outlined in Table 5, as discussed previously. Coping differences were observed by gender and age. As noted above, females scored higher than males on the EPOC measure and endorsed greater emotional support coping than males. Instrumental Support Coping was found to decrease with age (r=-.19, p<.01).

As summarized in Tables 15-19, only the Planning Coping and Self-Blame Coping subscales of the Brief COPE were found to be associated with exercise maintenance. Planning coping was endorsed at greater levels among participants who had relapsed, $t(202) = -2.12$, $p<.05$, in the previous year, and there was a trend for greater planning coping in participants who had lapsed, $t(203) = -1.95$, $p=.052$). Self-blame coping was endorsed at higher levels among participants who had lapsed, $t(203) = -3.85$, $p<.001$, and who were not adherent to CDC/ACSM Guidelines $t(190) = 2.06$,

$p<.05$, and was associated with slips ($r=.17$, $p=.02$). Associations between coping variables and exercise maintenance variables are summarized in Table 32.

Selection of Coping Measure for Use in Hypothesis 1 Analyses

Table 20 summarizes the intercorrelations between the various coping measures, and Table 21 summarizes the correlations between the coping measures and other exercise measures utilized in the study. The three coping measures were found to be unrelated, with the exception of the EPOC measure and its association with instrumental support coping ($r=.18$, $p<.05$). The Brief COPE subscales demonstrated substantially stronger convergent validity with other exercise measures, including vulnerability to relapse. The Brief COPE was also associated with exercise maintenance and mindfulness whereas the other coping measures were not. Thus, the Brief COPE subscales were selected for use in Hypothesis 1 analyses.

Lapse

In the RPM, the Abstinence Violation Effect follows a lapse. Lapse was assessed in the current study as endorsement of having missed 2 weeks of exercise in the previous one-year period. Demographic variables (gender, marital status, and age) were not associated with having lapsed in the previous year. Endorsement of lapse was associated with exercise transgressions, including slip frequency ($r=.19$, $p<.01$), the frequency of drop-outs over previous 5 years ($r=.19$, $p<.05$), lower exercise frequency (days per week) ($r=-.28$, $p<.01$) and fewer years of regular exercise ($r=-.15$, $p<.05$). Individuals who lapsed were more likely to have missed 3 consecutive weeks of exercise over the previous year, $\chi^2(1, N=222) =106.38$, $p<.01$, more likely to have relapsed over the past year, $\chi^2(1, N=217) = 28.26$, $p<.01$, less likely to have exercised regularly over the

previous month, $\chi^2(1, N=222) = 9.7, p<.01$, and year, $\chi^2(1, N=222) = 29.88, p<.01$, and were less adherent to CDC/ACSM guidelines, $\chi^2(1, N=204) = 7.92, p<.01$).

Abstinence Violation Effect Variables

As discussed above, the AVE is characterized by "(a) a causal attribution of responsibility for the slip and (b) an affective reaction to the attribution (Curry, Marlatt & Gordon, 1987, pg. 145)." In the current study, causal attributions regarding responsibility for an exercise lapse were assessed in addition to the associated affective response.

Attributions

Tables 15-19 summarize the associations between internal and stable causal attributions and exercise maintenance. Exercise slips were associated with lower internal and stable causal attributions. Participants who lapsed or relapsed had lower internal and less stable causal attributions. Participants who were regular exercisers or adherent to guidelines had greater internal and more stable causal attributions. Associations between internal and stable attributions and exercise maintenance variables are summarized in Table 33.

Tables 15-19 summarize the associations between attributions regarding perceived control and exercise variables. Exercise slips were associated with lower personal control attributions and greater external control attributions. Participants who had lapsed or relapsed had lower personal control attributions and greater external control attributions. Participants who were regular exercisers or adherent to guidelines had greater personal control attributions. Slips were associated with exercise distress, and participants who had lapsed or relapsed had lower exercise competence. Regular exercisers and participants who were adherent to guidelines reported greater exercise

competence. Associations between perceived control attributions and exercise maintenance variables are summarized in Table 34.

Affective Response

Tables 15-19 summarize the associations between Affective Measures and exercise variables. Slips are associated with greater guilt while dropped out of exercise and greater exercise distress. Participants who lapsed had greater guilt while dropped out and greater exercise distress. Participants who reported regular exercise or adherence with guidelines reported less exercise distress. Associations between affective responses and exercise maintenance variables are summarized in Table 35.

Abstinence Violation Effect Construct

Tables 15-19 summarize the associations between exercise variables and the AVE. Regular exercisers and participants who were adherent to guidelines had lower AVE1 (a high level of internal and stable causal attributions, a low level of personal control and a high level of associated exercise distress) scores. Higher AVE2 (high internal and stable causal attributions) was associated with fewer slips. Participants who had lapsed or relapsed had lower AVE2 (high internal and stable causal attributions) scores. Participants who were regular exercisers or who were adherent to guidelines had higher AVE2 (high internal and stable causal attributions) scores. AVE3 (low personal control and high exercise distress) was associated with slips. Participants who had lapsed or relapsed had higher AVE3 (low personal control and high exercise distress) scores. Participants who were regular exercisers or who were adherent to PA guidelines had lower AVE3 (low personal control and high exercise distress) scores. Associations

between the AVE variables and exercise maintenance variables are summarized in Table 36.

Mindfulness

Associations between mindfulness and exercise maintenance variables are summarized in Tables 15-19. Associations between mindfulness and RPM variables are summarized in Table 22. As in previous research, mindfulness was found to be associated with age (r=.20, p<.01), and the mean MAAS score for this physically active sample (M=4.18) was significantly higher, t(220) = 7.843, p<.0001) than norms reported by MAAS authors for a General Adult Sample (M=3.78) of similar age (M=43.27). Controlling for age, mindfulness was also found to be associated with days per week of moderate exercise (r=.19, p=.008) and frequency of exercise per week (r=.14, p=.04). Participants who had exercised regularly for the past year, t(201) = 2.27, p=.02) and who endorsed exercise success on the Causal Dimension Scale, t(191) = -2.11, p=.04) were higher in mindfulness. Participants who had missed 1 week of exercise over the past year were lower in mindfulness, t(199) = 2.00, p=.047. Mindfulness was also associated with relapse vulnerability and AVE exercise measures. Controlling for age, mindfulness was negatively correlated with: vulnerability to exercise relapse, exercise distress, and guilt while dropped out of exercise. Mindfulness was positively correlated with exercise competence. Mindfulness was also associated with causal attributions that reflect exercise success in this sample, as follows: internal attributions for cause; stability of attributions for cause; and personal control attributions. Associations between the mindfulness and exercise maintenance variables are summarized in Table 37.

Relapse Prevention Model Construct Associations

Figure 5 depicts the statistical model used to assess the Hypotheses, and the Pearson correlations between the RPM constructs. The expected relationships were found between many RPM constructs. However, outcome expectancies were not associated with coping or slip frequency, and AVE was not associated with Relapse in lapsers. As noted in Table 17, relapse was associated with AVE2 and AVE3 in the sample as a whole. Data on exercise self-efficacy was not collected.

Hypothesis 1 Analyses

In Hypothesis 1, it was predicted that mindfulness would significantly moderate the relationship between high-risk situation (i.e.-vulnerability to relapse) and coping response (Figure 3) such that, compared to more mindful participants, utilization of ineffective coping strategies among less mindful participants would be greater at higher levels of relapse vulnerability. Table 23 summarizes the findings of the hierarchical linear regression used to assess Hypothesis 1 with the Brief COPE for Exercise Emotional Support Subscale as dependent variables, Vulnerability to Relapse as the predictor variable, and mindfulness as the moderating variable, and displays R^2, ΔR^2 and ΔF for each step in the hierarchical regression analysis. The change in variance associated with the addition of the interaction term to the regression equation was significant. Mindfulness was found to significantly moderate the relationship between vulnerability to relapse and emotional support coping (p=.01). Figure 6 depicts the form of the effect of mindfulness as a moderator, and suggests that individuals who are low in mindfulness use significantly more emotional support coping (p=.006) at higher levels of relapse vulnerability, while individuals who are high in mindfulness use similar levels of

emotional support coping with both low and high levels of vulnerability to relapse (p=.69).

Table 24 summarizes the findings of the hierarchical linear regression used to assess Hypothesis 1 with the Brief COPE for Exercise Instrumental Support Subscale as the dependent variable, Vulnerability to Relapse as the predictor variable, and mindfulness as the moderating variable, and displays R^2, ΔR^2 and ΔF for each step in the hierarchical regression analysis. The change in variance associated with the addition of the interaction term to the regression equation approached significance (p=.06). Figure 7 depicts the form of the effect of mindfulness as a moderator, and suggests that individuals who are low in mindfulness use significantly more instrumental support coping (p=.01) at higher levels of relapse vulnerability, while individuals who are high in mindfulness use similar levels of instrumental support coping with both low and high levels of relapse vulnerability (p=.79).

Table 25 summarizes the findings of the hierarchical linear regression used to assess Hypothesis 1 with the Brief COPE Planning Coping Subscale as the dependent variable, Vulnerability to Relapse as the predictor variable, and mindfulness as the moderating variable, and displays R^2, ΔR^2 and ΔF for each step in the hierarchical regression analysis. The change in variance associated with the addition of the interaction term to the regression equation was not significant (p=.11), indicating that mindfulness did not moderate the relationship between vulnerability to relapse and planning coping. Figure 8 depicts the regression lines for high and low mindfulness participants.

Table 26 summarizes the findings of the hierarchical linear regression used to assess Hypothesis 1 with the Brief COPE Self-Blame Coping Subscale as the dependent variable, Vulnerability to Relapse as the predictor variable, and mindfulness as the moderating variable, and displays R^2, ΔR^2 and ΔF for each step in the hierarchical regression analysis. The change in variance associated with the addition of the interaction term to the regression equation was not significant (p=.98), indicating that mindfulness did not moderate the relationship between vulnerability to relapse and self-blame coping. Figure 9 depicts the regression lines for high and low mindfulness participants.

Hypothesis 2 Analyses

Hypothesis 2 predicted that mindfulness would significantly moderate the relationship between slip frequency and the abstinence violation effect (Figure 4) in lapsers, such that level of AVE among less mindful lapsers would be greater at higher slip frequencies, while level of AVE in more mindful lapsers would not differ at high and low slip frequencies. Table 27 summarizes the findings of the hierarchical linear regression used to assess Hypothesis 2 with AVE1 as the dependent variable, slip frequency as the predictor variable, and mindfulness as the moderating variable. The table includes R^2, ΔR^2 and ΔF for each step in the hierarchical regression analysis. The change in variance associated with the addition of the interaction term to the regression equation was not significant (p=.38), indicating that mindfulness did not moderate the relationship between slip frequency and AVE1 in lapsers. Figure 10 depicts the regression lines for high and low mindfulness participants.

Table 28 summarizes the findings of the hierarchical linear regression used to assess Hypothesis 2 with AVE2 as the dependent variable, slip frequency as the predictor variable, and mindfulness as the moderating variable. The table includes R^2, ΔR^2 and ΔF for each step in the hierarchical regression analysis. The change in variance associated with the addition of the interaction term to the regression equation approached significance (p=.06). Figure 11 depicts the form of the effect of mindfulness as a moderator, and suggests that lapsers who are low in mindfulness have significantly lower AVE2 (high internal by high stable attributions regarding exercise performance) at higher levels of slip frequency (p=.004), while high mindfulness lapsers have similar levels of AVE2 at both high and low slip frequencies (p=.59).

Table 29 summarizes the findings of the hierarchical linear regression used to assess Hypothesis 2 with AVE3 as the dependent variable, slip frequency as the predictor variable, and mindfulness as the moderating variable. The table includes R^2, ΔR^2 and ΔF for each step in the hierarchical regression analysis. The change in variance associated with the addition of the interaction term to the regression equation was not significant (p=.53), indicating that mindfulness did not moderate the relationship between slip frequency and AVE3 in lapsers. Figure 13 depicts the regression lines for high and low mindfulness participants.

Mindfulness as Moderator of RPM Constructs

Figure 13 depicts the statistical model used to assess the hypotheses and the variance explained by mindfulness in moderating relationships between RPM variables. Mindfulness significantly moderated the relationship between relapse vulnerability and emotional support coping. Mindfulness approached significance as a moderator of

relapse vulnerability and instrumental support coping, and as a moderator of slip frequency and AVE2 in lapsers.

DISCUSSION

In this study, relationships between constructs of the RPM were examined and the role of mindfulness in moderating these relationships was evaluated. Cross-sectional data and static constructs were used as proxies for the situationally defined constructs of the RPM and the sequelae of high-risk situations for exercise lapse. Mindfulness was predicted to moderate the relationships between the cross-sectional variables representing High-Risk Situation and Coping Response, and between Slip Frequency in Lapsers and the AVE such that, relative to more mindful participants, less mindful participants would endorse greater use of ineffective coping strategies at higher levels of relapse vulnerability and less mindful lapsers would endorse greater Abstinence Violation Effect at higher levels of slip frequency.

The study utilized a convenience sample of community exercisers recruited from YMCA facilities located in a metropolitan area of a Midwestern city. Participants were adult exercisers of relatively high socioeconomic status, were largely adherent to physical activity guidelines (78.2%), endorsed regular exercise (84.5%) and scored higher on the Mindful Attention and Awareness Scale (MAAS) relative to a normative sample of adults. Interestingly, MAAS scores in this physically active sample were similar to a sample of Zen meditation practitioners of similar age, and also similar to an older sample of cancer patients (Brown & Ryan, 2003).

Hypothesis 1

Mindfulness was found to moderate the relationship between vulnerability to relapse and certain types of coping. Thus, support for Hypothesis 1 was mixed, dependent upon the type of coping assessed. Although emotional support coping was not associated with exercise maintenance variables, it was associated with greater exercise distress (r=.15, p=.03) and less control while dropped out (r=-.20, p=.02). Thus, the finding of mindfulness as a moderator of the relationship between relapse vulnerability and emotional support coping provides some support for Hypothesis 1.

Similarly, although instrumental support was not associated with exercise maintenance variables, it was associated with vulnerability to relapse and frequency of missed one week periods of exercise over the previous year (r=.19, p=.04). Thus, the finding of a potential moderating effect of mindfulness (approaches significance) provides some additional support for Hypothesis 1. Although self-blame coping and planning coping were associated with lower exercise maintenance, mindfulness was not found to moderate the relationship between vulnerability to relapse and these types of coping. Thus, Hypothesis 1 was not supported for self-blame coping or planning coping.

In contrast with the findings of the current study, previous research has found that eliciting the help of others (a behavioral process of change) and planning (a cognitive coping strategy) were associated with positive physical activity. Both cognitive and behavioral coping strategies were found to be beneficial in promoting regular exercise (Simkin & Gross, 1994; Stetson, et al., 2005) in the few studies that have considered coping and physical activity. Some studies suggest that cognitive coping strategies are favored over behavioral coping strategies among regular exercisers (Stetson, et al., 2005),

and others suggest that behavioral processes of change are favored over experiential processes (Bock, et al., 2001; Bock, et al., 1997; Marcus, et al., 1992).

The inconsistency between previous findings regarding positive coping and the findings of the current study may reflect the psychometric properties of the Brief COPE as a coping measure for physical activity. The Brief COPE has not been used in previously published studies of physical activity, and there were no validated exercise coping measures available to establish convergent validity of the Brief COPE for exercise in the current study. However, the items within the Brief COPE subscales employed in Hypothesis 1 analyses (Table 30) are face valid and appear to be tapping the same constructs as those in previous research. Further, although none of the Brief COPE strategies emerged as being effective strategies for exercise maintenance, a pattern was observed in the associations between coping and exercise adherence. Exercise nonadherent participants endorsed significantly more use of the following avoidant coping strategies including: Behavioral Disengagement Coping; Distraction Coping; and Denial Coping. These findings are consistent with the larger coping literature in which avoidant coping is generally associated with negative outcomes (Carver & Scheier, 1994). Theoretical conceptualizations of mindfulness suggest that more mindful individuals are less likely to utilize avoidant coping. In the current study, greater endorsement of avoidant coping strategies in participants was associated with lower levels of mindfulness (behavioral disengagement approaches significance: $r=-.14$, $p=.058$), which is consistent with theoretical conceptualizations of mindfulness.

Among the more interesting of the findings of this study is that none of the coping strategies assessed by the Brief COPE were found to be positively associated with

exercise maintenance. At first glance, this finding raises questions regarding the reliability of study findings for coping, since some studies have identified positive coping strategies associated with exercise behaviors. However, the pattern observed in the present study is not necessarily discrepant with the larger coping literature. When considered as a whole, the coping literature has historically revealed more about ineffective coping than effective coping strategies (Carver & Scheier, 1994), and this observation has led some to question the benefit of assessing coping per se (Aldwin & Revenson, 1987 as cited in Carver & Scheier, 1994). More recent research has identified some consistent positive coping strategies that are situationally and contextually defined (Folkman & Moskowitz, 2004). As discussed below, context is emerging as one of the more important factors to be considered when conducting coping research.

Studies examining relationships between coping and outcomes are often designed to match specific stressors to specific coping strategies that are associated with positive outcomes. However, an accumulation of coping research reveals that the same coping strategy can be effective in certain contexts and ineffective in other contexts, even if the type of stressor remains constant (Folkman & Moskowitz, 2004). Further, the application of a coping strategy may be ineffective at one point in the progression of stressor, and effective at a later time. This proposition suggests that cross-sectional studies may be ineffective at capturing the complexities of matching effective coping strategies to context as could be accomplished with real-time research methodologies. With respect to the current study, it may be that the specific coping strategies assessed are not consistently associated with specific outcomes, or that certain subscales are consistently

associated with poor coping (e.g., substance use coping) while others are differentially effective (e.g., planning coping) depending upon context.

In summary, although the findings of the current study do not necessarily diverge from previous findings, the uncertainty regarding the validity of the Brief COPE in capturing exercise-related coping suggests only tentative support for a moderating role for mindfulness. Replication of these findings using a criterion validated measure of exercise coping would provide more solid evidence for a moderating role for mindfulness in coping with high-risk situations for exercise drop-out.

Hypothesis 2

As conceptualized in the Relapse Prevention model, the Abstinence Violation Effect is comprised of internal and stable attributions regarding the cause of a lapse, a sense of lost control, and associated guilt. In Hypothesis 2, it was predicted that mindfulness would moderate the relationship between slip frequency and AVE (Figure 4) in lapsers, such that level of AVE among less mindful lapsers would be greater at higher slip frequencies, while level of AVE in more mindful participants would not differ across high and low slip frequencies.

Mindfulness was found to be a potential moderator (approached significance) of the relationship between slip frequency and AVE2 (high internal by high stable attributions regarding exercise performance), such that less mindful lapsers endorsed significantly less AVE2 at higher slip frequencies while more mindful lapsers endorsed similar levels of AVE2 at both high and low slip frequencies. This finding would appear to contradict Hypothesis 2. However, the AVE was constructed as consistent with conceptualizations for substance abusers as described by Marlatt and Gordon (1985).

The findings of this study did not support the attributions component of the AVE as conceptualized by Marlatt and Gordon in the RPM. Rather than having high internal and stable attributions associated with missing exercise, exercise adherent participants had higher internal and stable attributions regarding exercise success, and more external and unstable attributions regarding exercise drop-out. Since both internal and stable attributions were positively correlated with exercise maintenance, a finding of potential moderation of mindfulness and AVE2 as depicted in Figure 11 suggests that lower mindfulness lapsers endorsed lower levels of success-related attributions at higher slip frequencies, while attributions of more mindful lapsers were constant across both high and low slip frequencies. Given that Hypothesis 2 analyses were somewhat underpowered to detect a medium effect size, the finding that mindfulness approaches significance as a moderator for the AVE2 analyses suggests support for Hypothesis 2.

Associations between internal and stable attributions observed in this study are consistent with a previous exercise study that found that exercisers who met their exercise goals made more internal, stable and personally controllable attributions relative to subjects who did not meet their exercise goals (Foster, 1994). In addition, a study by the author of the Causal Dimension Scale for Exercise "demonstrated a relationship between high adherence for exercise and more internal, somewhat stable, and personally controllable attributions for perceived exercise progress (McCauley, 1991 as cited in Foster, pg. 49, 1994)." As noted above, the AVE1 (high internal and high stable attributions, low personal control attributions, and high distress) variable utilized in the Hypothesis 2 analyses was constructed to be consistent with the AVE as conceptualized by Marlatt and Gordon. Since this conceptualization was not supported in the current

study, and lapse and AVE1 were not associated, it is not surprising that mindfulness was not found to moderate the relationship between lapse and AVE1.

Attributions made by exercisers in the previous studies (Foster, 1994; McAuley, 1991) and the current study are consistent with attribution bias (Seligman, 1990) as cited in Foster, 1994) in that participants took credit for exercise success and attributed exercise failure to external factors. Perhaps attribution bias is present in exercise behavior and not present in substance abuse because there are inherent differences in the behaviors of interest. The RPM has been applied to processes of change in both substance abuse and health promoting behaviors. However, the potential differences in the process of maintaining a positive behavior and abstaining from a negative behavior remain unexamined. Intuitively, it would seem that the two transgressions, failing to abstain from a negative behavior and failing to maintain a positive behavior, would be followed by cognitions and affect that differ in strength or type. For example, there may be differences in the latency between the undesirable behavior and the realization of adverse consequences. It could be argued that use of a substance results in more immediate adverse consequences. However, there appears to be no empirical support for this assertion. Research is needed that explicitly compares the cognitive and behavioral processes involved in acquisition and maintenance of a positive behavior relative to refraining from a negative behavior.

In contrast with AVE1, AVE2 (high internal and stable attributions) and AVE3 (low personal control and high distress) were both associated with lapse, but had the opposite relationship with lapse. This reflects the findings discussed above, that internal and stable attributions were associated with perceived exercise success rather than failure.

Thus, non-lapsers had higher internal and more stable attributions (AVE2) while lapsers had lower personal control and higher distress (AVE3). Although constructed to be consistent with theory, AVE3 reflected the adverse reaction to lapse as consistent with the RPM while AVE2 did not. The association between lapse and AVE3 (low personal control and high distress) in the current study provides support for the control and guilt components of the AVE.

It is not clear why the expected moderating effect of mindfulness was not observed for the relationship between slip frequency and AVE3 in lapsers. Although the relationship between predictor, moderator and dependent variable were present, the predicted buffering effect of mindfulness was not found. As discussed above, Hypothesis 2 analyses were somewhat underpowered to detect a medium effect size, and this might explain the failure to find the expected moderating effect of mindfulness. The potential statistical confounds of assessing moderation with regression were considered (Frazier, et al., 2004). The internal consistencies of the stability subscale (α=.68) of the Causal Dimension Scale for Exercise and the Distress subscale of the Demoralization Scale for Exercise (α=.76) were less than desirable. However, no other statistical concerns were identified regarding the use of regression for testing of moderator effects.

Secondary Analyses: Exercise and Mindfulness

Although this study demonstrated partial support for mindfulness as a moderator of RPM constructs, mindfulness was consistently associated with self-reported exercise success. Mindfulness was found to be associated with lower endorsement of lapse, less guilt and distress regarding exercise, lower vulnerability to exercise relapse, greater exercise success related attributions, and lower use of ineffective coping strategies. These

findings are consistent with those of a previous study conducted with YMCA exercisers (Ulmer, et al., 2004) that found that greater mindfulness was associated with greater self-efficacy for exercise and less guilt during exercise dropout.

As consistent with a previous study of YMCA exercisers in the Louisville metropolitan area (Ulmer, et al., 2004), participants in this study scored significantly higher on the MAAS than norms, and at levels that are comparable to a sample of Zen practitioners of similar age. There are several potential explanations for this finding. Perhaps more mindful individuals are more likely to engage in exercise, or conversely, exercise may enhance mindfulness. Mindfulness and physical activity may be associated with a third variable that explains the relationship, or perhaps more mindful individuals are more likely to participate in survey research. If mindfulness is associated with maintaining exercise, as suggested by many of the findings of the current study, high mindfulness individuals should be disproportionately represented in attendance at the YMCA. This might also explain the findings regarding high MAAS scores.

Interestingly, although mindfulness was not associated with endorsement of chronic health conditions, participants who were lower in mindfulness endorsed greater adverse impact of chronic health conditions on physical activity (pr=-.19, p=.01) after controlling for age. This finding is consistent with the premise of Mindfulness-Based Stress Reduction for chronic disease populations, that increased mindfulness facilitates better coping with physical symptoms. Empirical evidence suggests that although MBSR intervention participants may continue to endorse symptoms of chronic disease following the intervention, they are likely to experience lesser impact of disease on functioning (Salmon, Sephton, Weissbecker, Hoover, Ulmer, et al., 2004).

The findings of the current study provide some support for the model of mindfulness and mechanisms of action proposed by Shapiro and colleagues (Shapiro et al., 2006). They propose self-regulation as a mechanism of action for the associations between mindfulness and positive outcomes found in previous research. Coping has been conceptualized as a self-regulation process (Carver & Scheier, 2002, and Eisenberg, Fabes, & Guthrie, 1997 as cited in Folkman & Moskowitz, 2004), and self-regulatory and self-monitoring skills have been found to predict exercise participation (Marcus, et al., 1997). In the current study, use of certain coping strategies was dependent upon level of mindfulness. Emotional support coping (associated with greater exercise distress and less control while dropped out) and instrumental support coping (associated with greater vulnerability to relapse) were greater among individuals who were lower in mindfulness. Thus, the findings of the current study provide some support for the self-regulation mechanism of mindfulness in that, use of self-regulation in the form of specific coping strategies depended upon level of mindfulness.

Mindfulness is proposed by Shapiro and colleagues (Shapiro et al., 2006) as being related to other mechanisms of action as well, including: greater clarity and integrity regarding personal values; greater cognitive, emotional, and behavioral flexibility; and a greater capacity to tolerate exposure to distressing or previously avoided internal states. Perhaps the associations between mindfulness and exercise success observed in the current study are reflective of greater clarity of values among more mindful participants. It may be that mindful individuals attempting to maintain positive behavior change are less susceptible to reactivity regarding exercise failures than less mindful individuals, and that this reduced reactivity may result in greater resilience against the internal distress

and demoralization (AVE) that leads to eventual exercise-drop-out. Similarly, it may be that more mindful participants in the current study were able to tolerate a wider range of internal states, resulting in less likelihood of engaging in negative coping responses and greater tolerance for the internal sequelae of an exercise lapse, which in turn facilitated their ability to maintain exercise. This concept is consistent with the RPM, in that avoidance of distressing internal states in the form of a "no-coping response" is suggested as the mechanism by which a high-risk situation ultimately results in a lapse. Overidentification with cognitions and affect that follow a lapse increase the likelihood of relapse.

Acceptance-Based Exercise Interventions for Physical Activity Promotion

The finding of self-reported lower use of ineffective avoidant coping strategies by more mindful individuals suggests a potential role for interventions designed to target avoidance and increase mindfulness. Acceptance-based interventions such as Acceptance and Commitment Therapy (ACT) and Mindfulness-Based Stress Reduction (MBSR) are two such interventions. In fact, MBSR has been found to be efficacious in reducing avoidant coping in college males who utilized sex to cope with stress (Murray, 2005). However, Shapiro et al (2006) stress the importance of understanding the mechanisms of action of mindfulness, and that mindfulness-based interventions should be based upon an understanding of these mechanisms. Relational Frame Theory (RFT: Hayes, Barnes-Holmes, & Roche, 2001) is the theory underlying ACT. Regarding mindfulness, Hayes asserts that RFT "provides a contextually focused explanation for why normal verbal/cognitive processes undermine ''attention to the present moment'' and ''an attitude of acceptance" (pg. 251, Hayes & Shenk, 2004)", and that the creation of

contexts for learning of new behaviors should be the focus of techniques designed to enhance behavior change. Mindfulness techniques, such as meditation among others, are proposed by Hayes as the contexts under which this learning may occur. Thus, the associations between mindfulness and exercise observed in this study could be readily examined in future studies using RFT principles.

The Importance of Context

Contextual factors are often considered in health behavior change research. Factors such as stage of change, social support, weather and access to facilities are all contextual factors associated with physical activity (Trost, et al., 2002). The importance of context seems to be an emerging focus of research across many areas of psychological inquiry. As noted above, a shift is occurring in coping research that acknowledges differential effects of coping strategies dependent upon the context under which the strategies are employed (Folkman & Moskowitz, 2004). Marlatt's own RPM was recently revised from a static model to a dynamic model that considers interacting factors and context (Witkiewitz & Marlatt, 2004).

A similar dialogue regarding context is occurring in the emerging mindfulness and acceptance-based clinical psychology empirical domain. The operational definitions of mindfulness offered thus far (Bishop, et al., 2004; Shapiro, et al., 2006) are strongly linked to information processing theory. Hayes (Hayes & Shenk, 2004) asserts that the operational definition of a psychological construct should be free from an implicit theoretical orientation. This dialogue has particular relevance to the topic of context since it has been argued that psychological processes from a cognitive psychology perspective do not require consideration of context, whereas, historical and situational

contexts would be considered from a behaviorist's point of view (Hayes & Shenk, 2004). Hayes proposes RFT, a contextual psychology theory, as an alternative to strictly cognitive theories of mindfulness. RFT offers a "functional account of the structure of verbal knowledge and cognition, creating an important link between the traditionally disparate perspectives of cognitive and behavioral psychology (http://contextualpsychology.org/rft)."

Support for the Relapse Prevention Model for Exercise

Beyond assessing the role of mindfulness in exercise maintenance, this study was among the first to assess relationships between RPM constructs as applied to exercise maintenance. Certain RPM relationships were supported in the study, while others were not. Vulnerability to relapse was associated with coping, but not necessarily in the expected direction. As noted above, none of the coping strategies assessed using the Brief COPE emerged as positive coping strategies for exercise maintenance. However, this finding may reflect the potential inadequacy of the Brief COPE to capture exercise-related coping rather than an absent relationship between RPM constructs for exercise.

The study provides some support for the relationships between exercise transgressions (i.e.-slip, lapse, and relapse) and the AVE. Although relationships between exercise and the valence of causal attributions were not as expected, the expected relationships between other AVE variables and exercise transgressions were observed in this sample. Both slips and lapses were associated with guilt, exercise distress, and lower exercise competence.

As consistent with previous research examining the application of the RPM to exercise (Stetson, et al., 2005), females endorsed greater slip frequency than males, slip

frequency was associated with more guilt for both males and females, and slip frequency was not associated with perceived control while dropped out in females, but approached significance in males. Also consistent with the Stetson et al. (2005) findings, although females endorsed greater slip frequency, males and females did not differ on endorsement of lapse or relapse. Also relevant to gender differences in physical activity, although there was no difference between males and females on endorsement of chronic health problems, males endorsed greater adverse impact on physical activity level. The consistency across studies with respect to gender differences underscores the importance of considering gender differences in exercise maintenance research.

Validity of Exercise Measures

Measurement of coping proved to be a fundamental barrier to hypothesis testing in the current study. Three measures of coping were utilized in this study due to the absence of a validated exercise coping measure. Although one measure demonstrated relationships with self-reported exercise outcomes, the relationships were not always consistent with previous research. The other coping measures utilized in the study demonstrated inadequate convergent validity for use in hypothesis testing.

In the current study, lapse was defined as a period of two weeks without exercise based upon previous research regarding exercisers' perceptions of a lapse (Stetson, et al., 2005). Intuitively, it would seem that exercisers' perceptions of lapse would be a better predictor of actual exercise behavior than a researcher imposed definition. In fact, the two-week lapse variable was found to be associated with more exercise maintenance variables than were the one week or three week variables. A large percentage of participants endorsed having missed one week of exercise (78%), and a small percentage

endorsed having missed three weeks of exercise (26%). Thus, from a purely pragmatic standpoint, the two week lapse definition also performed better with parametric inferential statistics, since it divided participants into two almost evenly divided groups (42% lapse rate).

Relapse was defined, in the current study, as a period of three weeks without exercise after having exercised continuously for a period of 6 months or longer. Presuming that the endorsement rate in the current study (10.5%) reflects participants actual relapse behavior, assessment of relapse would require a very large sample to obtain an adequate number of relapsers for meaningful statistical comparisons. The low endorsement rate for relapse is believed to explain the absence of expected relationships between relapse and exercise maintenance variables and other measures.

Other measures utilized in the study performed well in terms of their associations with self-reported exercise maintenance. Both subscales of the Demoralization Scale for Exercise were consistently associated with self-reported exercise maintenance in the theoretically consistent direction. The item assessing guilt while dropped out of exercise was more strongly associated with self-reported exercise maintenance than was the dispositional guilt measure (Personal Feelings Questionnaire). Scores on the control while dropped out item were not associated with slips, and did not differ across groups for adherence status, self-reported exercise status, or relapse status.

With respect to attributions regarding locus of control, the personal control subscale of the Causal Dimension Scale for Exercise was associated with more exercise maintenance variables than the external control subscale. As discussed above, the internal and stable subscales of the Causal Dimension Scale for Exercise were

consistently associated with exercise maintenance, however, in the opposite direction of what would be predicted by the RPM. In summary, the Demoralization Scale for Exercise, Causal Dimension Scale for Exercise, and guilt while dropped out item differed across exercise maintenance status groups in a theoretically consistent pattern, suggesting that they are effective for measurement of exercise-related cognitions.

Chronic Health Conditions

Participants in this sample endorsed a variety of chronic health conditions. The decision to retain all participants in analyses despite the possibility that chronic health conditions could interfere with participants' ability to maintain physical activity was based on comparison of the sample to norms for Kentucky residents. As discussed above, it is believed that the findings of the current study will better generalize with the inclusion of participants endorsing chronic health problems at rates that are similar to the general population.

In contrast with participants in this sample who endorsed asthma at 35.8%, the prevalence of current asthma among Kentuckians in 2004 was 8.3% (Hughes, et al., 2006). However, participants in the current study were asked "Have you been diagnosed with Allergies/Asthma." Thus, the inclusion of 'allergies' in this item is believed to explain the increased rates of endorsement relative to rates of asthma among Kentuckians. Rates of arthritis and activity limitation due to arthritis endorsed in this sample are slightly lower but comparable to US prevalence rates of 27% endorsing arthritis (Hughes, et al., 2006). Kentuckians report "having been told that you have hypertension" at a rate of 29.8% (Hughes, et al., 2006) as compared to only 20.8% of participants in this sample. Since physical activity is associated with reduced risk for

development of hypertension (CDC/ACSM, 1995), it is not surprising that this physically active sample endorses lower rates relative to other Kentuckians.

About 10% of participants in this sample endorsed thyroid and gastrointestinal/digestive problems. Although there is little research on the prevalence of thyroid disease, rates of endorsement for this sample are comparable to rates of elevated TSH levels of 9.5% and decreased TSH levels of 2.2% found in the Colorado Thyroid Disease Prevalence Study (Canaris, Manowitz, Mayor, & Ridgway, 2000). There are no data available regarding the prevalence of gastrointestinal/digestive problems as a general category. However, global GERD (Gastroesophageal Reflux Disease) rates alone were estimated at 5-7% based upon a population-based study in Minnesota (Locke, Talley, Fett, Zinsmeister, & Melton, 1997). Thus, a GERD rate of 5-7% is consistent with a rate of 10.6% of participants in this sample endorsing GI/Digestive problems, a larger category under which GERD would be subsumed.

Implications and Recommendations

The findings of this retrospective recall study suggest that mindfulness may be associated with better exercise outcomes, that less mindful community exercisers may use certain ineffective coping strategies more often, and that more mindful individuals may be less susceptible to AVE-associated attributions following missed exercise sessions. Mindfulness was consistently associated with self-reported exercise maintenance in this cross-sectional study of adult community exercisers. However, it remains to be seen if the associations observed in this study would generalize if studied via prospective tracking and longitudinal design. Likewise, the findings observed using cross-sectional assessment of dispositional constructs may not reflect the sequelae of an

actual exercise lapse. Future studies should utilize objective assessment techniques and longitudinal study design to examine the role of mindfulness and the associated mechanisms of action in physical activity initiation and maintenance. Mindfulness-based physical activity interventions could be developed if these studies support a role for mindfulness in physical activity maintenance over time. As noted previously, further elucidation of causal associations between mindfulness and behavior is an important next step, since the development of mindfulness-based interventions should be based upon an understanding of mechanisms of action (Shapiro, et al., 2006).

Other questions to be addressed in future research are, "why are mindfulness scores in this sample higher than norms?" and "would the favorable relationship between mindfulness and exercise found in the current study would be observed in other health behaviors?" Does mindfulness facilitate health behavior change more generally? The findings of the current study suggest that examination of these questions is warranted.

The associations between avoidant coping and poorer self-reported exercise outcomes are particularly interesting when considering the increase in the use of equipment designed to distract exercisers during exercise. Televisions, radios and computers are increasingly present in fitness facilities, and are often attached to aerobic fitness equipment. However, it is unclear if these distractors are beneficial in promoting exercise maintenance. Perhaps, as consistent with some pain research (Jensen & Karoly, 1991), distraction techniques are differentially effective dependent upon level of pain or physical strain. Given the popularity of distractors in exercise facilities, an examination of their impact on exercise maintenance is warranted.

The findings of the current study underscore the need for the development of a valid measure of coping for physical activity. As discussed above, intermittent exercise seems to be the rule rather than the exception, and most Americans have dropped-out of an exercise program in the past. In fact, 68% of participants in the current study endorsed having dropped out of exercise in the past. With these ideas in mind, the focus of physical activity research is likely to shift from processes of exercise initiation to processes of exercise maintenance, and skill training to promote optimal coping in the presence of high-risk situations would be an important component of interventions designed to promote maintenance of physical activity.

Physical activity researchers should consider the time frame used to define relapse among adult community exercisers when designing studies to assess exercise relapse to assure adequate power. Further, future studies should more thoroughly evaluate the criterion validity of various definitions of lapse and relapse using prospective study methodologies. Research is also needed that explicitly compares the cognitive and behavioral processes involved in acquisition and maintenance of a positive behavior relative to those involved in refraining from a negative behavior.

Differences were found in exercise maintenance and cognitive factors based upon ethnicity and SES. Although these demographic factors were included as control variables in the current study, additional research is needed that focuses on predictors of exercise maintenance in African Americans and lower SES adults.

Strengths and Limitations

This was the first study to assess associations between mindfulness and health behavior change processes, and the observed associations between mindfulness and self-

reported exercise success open the door for future research on the role of mindfulness in physical activity and health behavior change. This study also contributed to the existing literature on exercise maintenance and provides guidance regarding the utility of various exercise measures in physical activity research. The study was based on a theory that enjoys considerable empirical support and a model that can be tested and modified as necessary for application to health behavior. When considered in light of other study findings, this study raises questions regarding the validity of the attributions component of the AVE as applied to exercise, and sets the stage for an examination of differences in AVE across various behavioral change domains.

Limitations of this study include the use of retrospective recall of exercise behavior. Real-time monitoring strategies such as ecological momentary assessment and the collection of longitudinal data may better facilitate an understanding of relapse processes. This study also utilized a convenience sample comprised of individuals whose household incomes and education levels were considerably higher than adults in the area from which the data was collected, and higher than national averages. Further, females were overrepresented in this sample. Thus, the findings of the study should be considered in light of the self-selection process inherent in the recruitment strategies employed. Findings regarding physical activity maintenance processes in this study should be extended to assess their applicability in lower SES populations. Although recruitment strategies were implemented to increase representation among African-Americans, they represented a lower percentage of participants in this sample (11.5 %) than the metropolitan area (Jefferson County, Kentucky: 19.8%) (U.S. Census Bureau, 2004) from which most of the sample was obtained. However, since 16% of the sample

was collected in Clark County, Indiana which has an African-American population of 7% (U.S. Census Bureau, 2004), the overall representation of African-Americans in the present study should be only somewhat lower than that of the combined Louisville and Southern Indiana metropolitan areas. Finally, study findings for this very active sample may not generalize to less active adults. Future studies should extend the findings of this study to non-exercising community samples, and interventions designed to target these populations based upon the findings of this study should first assess the associations between mindfulness and physical activity in non-exercisers.

Summary

In this cross-sectional study of YMCA exercisers, mindfulness was assessed as a moderator of relationships between Relapse Prevention Model constructs as applied to exercise maintenance. Mindfulness was found to be consistently associated with self-reported exercise maintenance and cognitive predictors of physical activity. Preliminary support was found for mindfulness in moderating the use of certain ineffective coping strategies in response to high-risk situations for exercise drop-out. This finding should be replicated using a criterion validated measure of exercise coping. Preliminary support was also found for mindfulness in buffering the impact of missed exercise sessions on attributions regarding exercise performance, with less mindful lapsers experiencing lower success-related attributions at higher numbers of missed sessions. Collectively, the findings of this study support the premise that mindfulness may be an important factor in physical activity promotion. This line of inquiry should be extended using longitudinal study design and prospective data collection techniques. These findings should also be

extended to assess potential associations between mindfulness and other health promoting behaviors.

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APPENDICES

TABLES

Table 1

Factors associated with overall physical activity in U.S. adults

Factor	Association Direction
Age	–
Education	+
Gender (Male)	+
Hereditary	+
Income/socioeconomic status	+
Overweight/obesity	–
Race/ethnicity (nonwhite)	–
Barriers to exercise	–
Enjoyment of exercise	+
Expected Benefits	+
Intention to Exercise	+
Lack of time	–
Mood Disturbance	–
Perceived health or fitness	+
Self-efficacy	+
Self-motivation	+
Self-schemata for exercise	+
Stage of change	+
Activity history during adulthood	+
Dietary habits (quality)	+
Past exercise program	+
Processes of change	+
Physician influence	+
Social support from friends/peers	+
Social support from spouse/family	+
Climate/season	–
Perceived effort	–

Note. Adapted from Trost, et al., 2002.

Table 2

Measures Assessing Relapse Prevention Model Constructs

Observed Construct	Measure
High Risk Situation	Reasons for Relapse Scale
Mindfulness	Mindful Attention and Awareness Scale
Coping Response	Exercise Processes of Change
	Total # of coping Responses generated for the self-report Exercise Coping Task (ECT)
	Brief Cope for Exercise
Outcome Expectancies	Outcome Expectancies for Exercise
Lapse	Endorsement of Lapse over the Previous 1 Year Period
Abstinence Violation Effect	Personal Feelings Questionnaire
	Causal Dimension Scale
	Guilt and Control Items
	Demoralization Scale for Exercise
Relapse	Endorsement of Relapse over the Previous 1 Year Period

Table 3

IPAQ Scoring Protocol

Physical Activity Level	
Low	
	No Activity is Reported OR Some activity is reported but not enough to meet Categories 2 or 3.
Moderate	
	3 or more days of vigorous activity of at least 20 minutes per day OR 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day OR 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes/week.
High	
	Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week OR 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week

Note. Taken from IPAQ Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire, pg. 13.

Table 4

Summary of Factor Loadings for Oblique Rotation Three-Factor Solution for a Coping Factor extracted from the Exercise Processes of Change Questionnaire

		Factor Loading		
	Item	1	2	3
1.	I put things around my home to remind me of exercising.	.79		
2.	I keep things around my place of work that remind me to exercise.	.78		
3.	I recall information people have personally given me on the benefits of exercise.	.73		
4.	I think about the information from articles and advertisements on how to make exercise a regular part of my life.	.73		
5.	I tell myself that if I try hard enough I can keep exercising.	.67		
6.	I tell myself I am able to keep exercising if I want to.		.86	
7.	I make commitments to exercise.		.78	
8.	I have someone on whom I can depend when I am having problems with exercising.			-.92
9.	I have a healthy friend that encourages me to exercise when I don't feel up to it.			-.90

Table 5

Internal Consistency of Selected Brief COPE Subscales

Brief COPE Subscale	Cronbach's Alpha Statistic
Instrumental Support	.81
Behavioral Disengagement	.37
Positive Framing	.63
Planning	.73
Acceptance	.57
Self-Blame	.74
Self-Distraction	.40
Active	.66
Denial	.62
Emotional Support	.77

Table 6

Abstinence Violation Effect Variables and their Components

AVE	Components
AVE1	Internal Causal Attributions X Stable Causal Attributions X Reverse Scored Personal Control Attributions X Exercise Distress
AVE2	Internal Causal Attributions X Stable Causal Attributions
AVE3	Reverse Scored Personal Control Attributions X Exercise Distress

Table 7

Relapse Prevention Model Measures, Means, and Standard Deviations

Observed Construct	Measure and Subscales	*n*	% of Total	*M* (Range)	*SD*	Differ by Gender
Vulnerability to Relapse	Reasons for Relapse Scale	167	82.2[a]	19.98 (12-38)	5.19	
Mindfulness	Mindful Attention and Awareness Scale	203	89.8	62.99 (23-90)	11.1	
Coping	Exercise Processes of Change	203	89.9	14.30 (5-25)	4.98	*
	Exercise Coping Task	215	95.1	11.66 (3-22)	3.72	
	Brief Cope for Exercise					
	Emotional Support	210	92.9	2.15 (1-4)	1.73	*
	Instrumental Support	207	91.6	2.05 (1-4)	1.76	
	Planning Coping	209	92.5	2.58 (1-4)	1.90	
	Self-Blame Coping	209	92.5	2.01(1-4–)	1.75	
Outcome Expectancies	Outcome Expectancies for Exercise	215	95.1	1.57 (1-5)	.81	

Observed Construct	Measure and Subscales	*n*	% of Total	*M*	*SD*	Differ by Gender
Abstinence Violation Effect						
	Guilt					
	Personal Feelings Questionnaire	201	88.9	7.8 (1-19)	3.81	
	Guilt while dropped out of exercise	150	95.8[b]	6.00 (0-10)	3.43	*
	DSE-Distress	208	92.0	1.84 (1-3.83)	0.64	
	Perceived Control					
	Personal Control	190	84.1	22.21 (3-27)	5.02	
	External Control	186	82.3	10.48 (3-27)	5.77	
	DSE-Incompetence	208	92.0	3.92 (1-5)	0.76	

Observed Construct	Measure and Subscales	*n*	% of Total	*M*	*SD*	Differ by Gender
	Attributions regarding Exercise Success					
	Internal	183	81.0	22.06 (6–27)	5.05	
	Stable	186	82.3	18.45 (3-27)	5.61	

[a] % of participants endorsing missed 1 week of exercise in past year, [b] % of participants endorsing having dropped out in the past, * Females scored significantly higher (p<.05), DSE=Demoralization Scale for Exercise.

Table 8

Distribution of Age, Gender and Ethnicity by Data Collection Site

Site	*N*	Age[a]		Gender		Ethnicity[b]		
				Female	Male	Caucasian	African-American	Other
		M	*SD*	%			%	
Northeast YMCA	63	52.51	14.52	63.5	33.3	90.5	7.9	1.6
Southeast YMCA	52	49.92	14.03	55.8	44.2	82.7	13.5	3.8
Southwest YMCA	25	51.44	17.22	56	32	92	8	0
Oldham County YMCA	29	49.32	9.29	58.6	37.9	96.6	0	0
Chestnut Street YMCA	5	77.20	7.01	100	0.0	0	100	0
Downtown YMCA	15	49.71	14.75	66.7	33.3	73.3	26.7	0
Southern Indiana YMCA	37	41.09	12.63	75.7	24.3	86.5	8.1	2.7
Overall	226	49.96	14.73	63.3	34.1	85.8	11.5	1.7

[a] significantly different across sites (F=6.071, p<.001). [b] significantly different across sites (χ^2=51.86, p=<.001)

Table 9

Demographic Characteristics of Participants (*N*=226)

Characteristic	*n*	%	*M*	*SD*
Age			49.96	14.73
age under 30	18	8.2		
In 30s	36	16.4		
In 40s	63	28.6		
In 50s	45	8.2		
In 60s	29	13.2		
In 70s	25	11.4		
In 80s	4	1.8		
Gender				
Female	143	65.0		
Male	77	35.0		
Ethnicity				
African American	26	11.5		
Caucasian	194	85.8		
Hispanic	3	1.3		
Asian	1	0.4		
Marital Status				
Never Married	23	10.2		
Currently Married	162	71.7		

Characteristic	*n*	%	*M*	*SD*
Separated	1	0.4		
Divorced	25	11.1		
Widowed	13	5.8		
Education				
Less than 7th grade	1	0.4		
Partial high school	1	0.4		
High School graduate	18	8.0		
Partial college/specialized training	50	22.1		
College or university graduate	81	35.8		
Graduate professional training	72	31.9		
Income				
Less than $10,000	2	1.0		
$10,000	7	3.3		
$20,000	26	12.4		
$40,000	35	16.7		
$60,000	85	40.5		
Greater than $100,000	55	26.2		
Employment				
Full time at job	120	53.1		
Part time at job	25	11.1		

Characteristic	*n*	%	*M*	*SD*
Disabled	3	1.3		
Seeking work	4	1.8		
Retired	45	19.9		
Homemaker	25	11.1		
Student	3	1.3		
Number of Children under 18 in Home				
.00	133	61.6		
1.00	31	14.4		
2.00	31	14.4		
3.00	19	8.8		
4.00	1	0.4		
5.00	0	0.0		
6.00	1	0.4		

Table 10

Comparison of Participants on Demographic Characteristics to Relevant Regional and National Samples

	Current Sample of YMCA Exercisers	Census 2000 City of Louisville	Census 2000 Kentucky	Census 2000 United States	Community Sample San Diego, CA Sallis, et al., 1989
Female %	65	52.7	51.1	50.8	42
Caucasian %	86.6	62.9	90.1	80.4	88
African American %	11.6	33.0	7.3	12.8	2
Household Income	$60-$100,000 Modal Category	$28,843 Mean	$36,663 Mean	$43,318 Mean	$20-$49,999 Modal Category
High School Graduate %	99.1	76.1	74.1	80.4	90

Table 11

Health Characteristics of Participants

Characteristic	*N*	%	*M*	*SD*
How would you rate your present health condition?				
Poor	2	0.9		
Fair	26	11.6		
Good	96	42.7		
Excellent	101	44.9		
Current Pain Endorsed	96	48.5		
Body Mass Index			26.62	5.73
Body Mass Index Group				
Normal weight	101	45.5		
Overweight	79	35.6		
Obese	31	14.0		
Super Obese	11	5.0		
Smoking Status				
Never		60.2		
past smoker		34.5		
current smoker		4.4		

Table 12

Chronic Health Conditions Endorsed by Participants

Chronic Health Condition	Have you been diagnosed with:		Does this condition affect your physical activity level?	
	N	% of total - yes	*N*	% of total – yes
Allergies/Asthma	81	35.8	23	10.2
Arthritis	51	22.6	31	13.7
Cancer	16	7.1	0	0
Cardiovascular Disease	18	8.0	7	3.1
Diabetes	11	4.9	5	2.2
Gastrointestinal/Digestive Problems	24	10.6	2	.9
Hypertension	47	20.8	2	.9
Kidney Disease/Problems	9	4.0	0	0
Liver Disease/Problems	1	.4	0	0
Respiratory Problems	5	2.2	2	.9
Thyroid Disorder	22	9.7	4	1.8

Chronic Health Condition	Have you been diagnosed with:		Does this condition affect your physical activity level?	
	N	% of total - yes	*N*	% of total – yes
≥1 Chronic Health Condition	150	66.4	57	25.2

Table 13

Physical Activity Characteristics of Participants

Characteristic	*n*	%	*M*	*SD*
CDC/ACSM Guidelines				
Adherent	161	78.2		
Non-Adherent	45	21.8		
Physical Activity Status (IPAQ)				
Low Level PA	18	8.6		
Moderate Level PA	54	25.7		
High Level PA	138	65.7		
Self-Reported Physical Activity Level				
Very Inactive	18	8.0		
Below Average	18	8.0		
Average	55	24.6		
Above Average	111	49.6		

Characteristic	*n*	% (Range)	*M*	*SD*
Very High	22	9.8		
Days per week of Vigorous Physical Activity	217	(0-7)	3.62	1.83
Minutes of Vigorous Physical Activity per Exercise Bout	216	(0-240)	70.38	55.79
Vigorous Activity METs per Exercise Bout	216	(0-1920)	563.06	446.31
Days per week of Moderate Physical Activity	204	(0-7)	2.99	2.32
Minutes of Moderate Physical Activity per Exercise Bout	190	(0-240)	64.12	67.75
Moderate Activity METs per Exercise Bout	190	(0-960)	256.47	271.01
How often do you exercise? (in # of days/wk.)			4.08	1.46
Regular exerciser? (Yes)	191	84.5		
Have you exercised regularly for the past year? (Yes)	162	71.7		
Ever started an exercise program and dropped out for a while? (Yes)	142	62.8		
On the average how many days per week did you plan to exercise during the past month?	225	(1-7)	4.40	1.36

Characteristic	*n*	%	*M*	*SD*
How many days per week would you estimate that you actually exercised during the past month?	223	(0-7)	3.99	2.49
Exercise Omissions (Retrospective Report of Planned Days minus Actual Days of Exercise)	223	(-2-4.2)	0.54	1.00
Over the previous year have you missed 1 full week of exercise? (Yes)	174	78.0		
Over the previous year have you missed 2 continuous weeks of exercise? (Yes)	93	41.9		
Over the previous year have you missed 3 continuous weeks of exercise? (Yes)	58	26.0		
Over the previous year have you missed 3 continuous months of exercise after having consistently exercised for a period of 6 months or longer? (Yes)	23	10.5		

Characteristic	*n*	%	*M*	*SD*
How many days or weeks did you miss before you felt you had dropped out or "relapsed"? (coded in days)	139	(0-365)	40.20	63.28
Endorse Chronic Disease as Impacting Physical Activity	57	28.5		

Table 14

Comparison of Participants on Physical Activity Characteristics to Relevant Regional and National Samples

	Current Sample of YMCA Exercisers Louisville 2005	BRFSS, 2005 Louisville Metropolitan Area	BRFSS, 2005 United States	Community Sample San Diego, CA Sallis, et al., 1989
CDC/ACSM Adherent: Adults with 30+ minutes of moderate physical activity five or more days per week, or vigorous physical activity for 20+ minutes three or more days per week (%)	78.2	38.1	48.7	na
Adults with 20+ minutes of vigorous physical activity three or more days per week (%)	73.2	20.6	27.4	32-46%

	Current Sample of YMCA Exercisers Louisville 2005	BRFSS, 2005 Louisville Metropolitan Area	BRFSS, 2005 United States	Community Sample San Diego, CA Sallis, et al., 1989
Mean Exercise Sessions per Week (*SD* or 95% Confidence Interval)	3.83 (*SD*=1.51)	na	na	2.0 (*CI*=1.9-2.1)
BMI Category Overweight (%)		35.8	36.7	na

Note. na=not available

Table 15

Intercorrelations between Slips, and Exercise Measures and Mindfulness

Measure	Slips (*r*)
Reasons for Relapse Scale	.19**
Exercise Coping Task (ECT)	-.05
Exercise Processes of Change (EPOC)	.10
Brief COPE for Exercise	
Emotional Coping	.04
Instrumental Support Coping	.08
Planning Coping	.19**
Self-Blame Coping	.17*
Causal Dimension Scale-Internal Causation Subscale	-.11
Causal Dimension Scale-Stable Causation Subscale	-.33**
Causal Dimension Scale-Personal Control	-.18*
Causal Dimension Scale-External Control	-.05
Control while dropped out of exercise?	-.15
Demoralization Scale for Exercise-Competence	-.16*
Dispositional Guilt (Personal Feelings Questionnaire)	.13
Guilt while dropped out of exercise?	.27**
Demoralization Scale for Exercise – Distress	.30**

Measure	Slips (*r*)
AVE1	.10
AVE2	-.28**
AVE3	.24**
Mindfulness	-.08

**$p<.01$. *$p<.05$.

Table 16

Mean Differences on Lapse by Exercise Measure and Mindfulness

	Lapse in the past year?		
	No	Yes	
	M (*SD*)		*t*
	No	Yes	
Reasons for Relapse Scale	18.70 (4.92)	21.87 (5.59)	-3.95**
Exercise Coping Task (ECT)	11.75 (3.90)	11.62 (3.44)	.25
Exercise Processes of Change (EPOC)	14.32 (5.45)	14.16 (4.21)	.22
Brief COPE for Exercise			
Emotional Support Coping	2.13 (.87)	2.20 (.86)	-.64
Instrumental Support Coping	2.01 (.83)	2.12 (.94)	-.92
Planning Coping	2.47 (.98)	2.73 (.91)	-1.95*
Self-Blame Coping	1.83 (.79)	2.29 (.92)	-3.85**
Causal Dimension Scale-Internal Causation	22.97 (4.34)	20.93 (5.36)	2.82**
Causal Dimension Scale-Stable Causation	19.86 (4.58)	16.56 (6.30)	4.10**
Causal Dimension Scale-Personal Control	23.32 (4.21)	20.70 (5.35)	3.74**
Causal Dimension Scale-External Control	9.61 (5.68)	11.95 (5.65)	-2.75**

	Lapse in the past year?		
	No	Yes	
	M (*SD*)		*t*
Control while dropped out of exercise?	4.167 (3.46)	3.64 (2.98)	.99
Demoralization Scale for Exercise-Competence	4.02 (.80)	3.77 (.66)	2.34*
Dispositional Guilt (PFQ)	7.37 (3.53)	8.42 (4.15)	-1.93
Guilt while dropped out of exercise?	5.16 (3.70)	6.86 (2.93)	-3.12**
Demoralization Scale for Exercise-Distress	1.73 (0.57)	2.00 (0.70)	-3.03**
AVE1	65.44 (18.06)	70.69 (22.57)	-1.69
AVE2	468.68 (162.88)	361.19 (196.47)	3.96**
AVE3	3.23 (1.30)	4.19 (1.69)	-4.34**
Mindfulness	4.30 (.74)	4.05 (.72)	2.33*

**p<.01. *p<.05.

Table 17

Mean Differences on Relapse by Exercise Measure and Mindfulness

	Relapse in the past year?		
	No	Yes	
	M (*SD*)		*t*
Reasons for Relapse Scale	19.66 (5.30)	22.05 (3.83)	-1.95
Exercise Coping Task (ECT)	11.85 (3.77)	11.11 (2.54)	.85
Exercise Processes of Change (EPOC)	14.30 (5.11)	14.23 (3.84)	.06
Brief COPE for Exercise			
Emotional Support Coping	2.15 (.88)	2.21 (.84)	-.26
Instrumental Support Coping	2.08 (.90)	1.96 (.78)	.65
Planning Coping	2.54 (.97)	2.98 (.70)	-2.12*
Self-Blame Coping	1.98 (.87)	2.17 (.81)	-1.00
Causal Dimension Scale-Internal Causation	22.38 (4.72)	18.71 (5.77)	3.13**
Causal Dimension Scale-Stable Causation	18.845 (5.57)	15.71 (4.58)	2.47*
Causal Dimension Scale-Personal Control	22.46 (4.73)	20.24 (5.56)	1.98*
Causal Dimension Scale-External Control	10.64 (5.67)	11.24 (6.30)	-.45
Control while dropped out of exercise?	3.82 (3.28)	3.85 (2.78)	-.04

	Relapse in the past year?		
	No	Yes	
	M (*SD*)		*t*
Demoralization Scale for Exercise-Competence	3.94 (.76)	3.79 (.57)	.85
Dispositional Guilt (PFQ)	7.86 (3.86)	6.82 (3.80)	1.20
Guilt while dropped out of exercise?	5.87 (3.52)	6.60 (2.68)	-.89
Demoralization Scale for Exercise - Distress	1.81 (0.62)	2.08 (0.73)	-1.88
AVE1	67.33 (19.92)	70.66 (24.35)	-.66
AVE2	437.92 (183.37)	315.53 (161.46)	2.71**
AVE3	3.55 (1.48)	4.30 (1.83)	-2.13*
Mindfulness	4.20 (.75)	4.21 (.62)	-.02

**p<.01. *p<.05.

Table 18

Mean Differences on Perceived Exerciser Status by Exercise Measure and Mindfulness

	Regular Exerciser?		
	No	Yes	
	M (*SD*)		*t*
Reasons for Relapse Scale	22.93 (5.59)	19.44 (4.96)	3.28**
Exercise Coping Task (ECT)	10.74 (2.92)	11.82 (3.84)	-1.49
Exercise Processes of Change (EPOC)	13.65 (3.71)	14.38 (5.20)	-.75
Brief COPE for Exercise			
Emotional Support Coping	1.93 (.70)	2.18 (.89)	-1.46
Instrumental Support Coping	1.95 (.78)	2.06 (.90)	-.63
Planning Coping	2.6 (.99)	2.56 (.94)	.23
Self-Blame Coping	2.15 (.99)	1.97 (.84)	1.08
Causal Dimension Scale-Internal Causation	19.24 (5.18)	22.61 (4.77)	-3.34**
Causal Dimension Scale-Stable Causation	15.33 (5.50)	19.10 (5.41)	-3.33**
Causal Dimension Scale-Personal Control	18.60 (5.47)	22.89 (4.53)	-4.53**
Causal Dimension Scale-External Control	11.56 (6.05)	10.30 (5.76)	1.04
Control while dropped out of exercise?	3.20 (2.83)	3.98 (3.28)	-1.11

	Regular Exerciser?		
	No	Yes	
	M (*SD*)		*t*
Demoralization Scale for Exercise-Competence	3.43 (.75)	4.02 (.73)	-4.16**
Dispositional Guilt (PFQ)	8.28 (4.62)	7.67 (3.64)	0.80
Guilt while dropped out of exercise?	6.92 (3.12)	5.80 (3.47)	1.50
Demoralization Scale for Exercise-Distress	2.30 (0.80)	1.75 (0.58)	4.47**
AVE1	80.63 (22.48)	65.36 (19.23)	3.58**
AVE2	306.98 (168.83)	449.20 (180.39)	-3.74**
AVE3	5.00 (1.80)	3.38 (1.39)	5.39**
Mindfulness	4.14 (.75)	4.22 (.74)	-.57

**$p<.01$. *$p<.05$.

Table 19

Mean Differences on Adherence to Public Health Exercise Guidelines by Exercise Measure and Mindfulness

	Adherent to CDC/ACSM Guidelines?		
	No	Yes	
	M (*SD*)		*t*
Reasons for Relapse Scale	22.34 (5.31)	19.30 (4.69)	3.28**
Exercise Coping Task (ECT)	11.60 (3.43)	11.92 (3.81)	-.51
Exercise Processes of Change (EPOC)	13.81 (4.56)	14.32 (5.07)	-.58
Brief COPE for Exercise			
Emotional Support Coping	2.21 (.83)	2.13 (.87)	.51
Instrumental Support Coping	2.22 (.89)	2.03 (.88)	1.19
Planning Coping	2.72 (.80)	2.55 (.96)	1.09
Self-Blame Coping	2.24 (.97)	1.94 (.82)	2.06*
Causal Dimension Scale-Internal Causation	20.50 (5.21)	22.75 (4.38)	-2.73**
Causal Dimension Scale-Stable Causation	16.56 (5.70)	19.40 (5.04)	-3.11**
Causal Dimension Scale-Personal Control	20.00 (5.97)	23.22 (3.86)	-4.14**
Causal Dimension Scale-External Control	10.44 (5.89)	10.84 (5.78)	-0.39

	Adherent to CDC/ACSM Guidelines?		
	No	Yes	
	M (*SD*)		*t*
Control while dropped out of exercise?	3.14 (2.47)	4.02 (3.35)	-1.41
Demoralization Scale for Exercise-Competence	3.69 (.73)	4.04 (.68)	-3.00**
Dispositional Guilt (PFQ)	8.58 (4.14)	7.69 (3.65)	1.32
Guilt while dropped out of exercise?	6.41 (3.22)	5.93 (3.45)	0.72
Demoralization Scale for Exercise – Distress	2.23 (0.70)	1.73 (0.56)	4.83**
AVE1	75.43 (23.67)	65.87 (18.84)	2.58*
AVE2	349.84 (182.36)	457.86 (170.76)	-3.43**
AVE3	4.45 (1.83)	3.33 (1.29)	4.38**
Mindfulness	4.09 (.75)	4.23 (.69)	-1.10

**$p<.01$. *$p<.05$.

Table 20

Intercorrelations between Exercise Coping Measures

Measure	1	2	3	4	5	6
1. Exercise Coping Task	-					
2. Brief COPE Instrumental Support	.05	-				
3. Brief COPE Planning	.07	.52**	-			
4. Brief COPE Self-Blame	-.04	.25**	.28**	-		
5. Brief COPE Emotional Support	.02	.68**	.47**	.17*	-	
6. Exercise Processes of Change	.03	.18*	.05	.03	.13	-

*p<.05, **p<.01

Table 21

Pearson Correlations between Coping, and other RPM-related Constructs and Mindfulness

	ECT [a]	EPOC [b]	Emotional Support	Instrumental Support	Planning	Self-Blame
Reasons for Relapse	-.09	-.03	.14	.21**	.29**	.23**
Exercise Distress	-.09	-.01	.15*	.17*	.25**	.35**
Exercise Incompetence	-.20**	.02	-.05	-.09	-.08	.19**
Control while dropped out	-.08	-.01	-.20*	-.15	-.11	-.08
Guilt while dropped out	.12	.19*	.04	.09	.29**	.25**
Positive Outcome Expectations	-.05	-.07	.10	.07	.08	.07
Internal Attributions	.14	.15*	.07	.05	-.16*	-.09
Stability of Attributions	.16*	.01	-.02	-.07	-.17*	-.31**
Personal Control Attributions	.19**	.08	-.02	-.03	-.08	-.19**
External Control Attributions	.04	.01	-.11	-.18*	-.11	.04

	ECT [a]	EPOC [b]	Emotional Support	Instrumental Support	Planning	Self-Blame
Mindfulness[c]	.00	.11	.21**	.29**	.21**	.32**

[a] Exercise Coping Task. [b] Exercise Processes of Change. [c]Partial correlation controlling for Age. *$p<.05$, **$p<.01$.

Table 22

Partial Correlations between Mindfulness and RPM Variables[a]

	Mindfulness (*pr*)
Vulnerability to Relapse (Reasons for Relapse Scale)	-.26**
Emotional Support Coping	-.22**
Instrumental Support Coping	-.32**
Planning Coping	-.22**
Self-Blame Coping	-.33**
Lapse	-.16*
Exercise Distress	-.30**
Exercise Incompetence	-.28**
Control while dropped out	.12
Guilt while dropped out	-.30**
Positive Outcome Expectations	-.11

	Mindfulness (*pr*)
Internal Attributions	.29**
Stability of Attributions	-.11
Personal Control Attributions	-.17*
External Control Attributions	.34**
AVE1 (↑Internal Attributions x ↑Stable Attributions x ↓Personal Control x ↑Exercise Distress)	-.28**
AVE2 ((↑Internal Attributions x ↑Stable Attributions)	-.26**
AVE3 (↓Personal Control x ↑Exercise Distress)	-.22**

[a] Controlling for age. [b] approaches significance (p=.059). *$p<.05$, **$p<.01$.

Table 23

Summary of Hierarchical Linear Regression Analysis with Coping (Brief COPE Emotional Support) as Criterion (N=129)

Step	Predictor Variable	R^2	ΔR^2	ΔF
1	Age, Gender, Ethnicity, Income, Education	.03	.03	.89
2	Mindfulness & Vulnerability to Relapse	.08	.05	3.64*
3	Interaction Term (Mindfulness x Vulnerability to Relapse)	.12	.04	6.61*

*p<.05.

Table 24

Summary of Hierarchical Linear Regression Analysis with Coping (Brief COPE Instrumental Support Coping) as Criterion (*N*=126)

Step	Predictor Variable	R^2	ΔR^2	ΔF
1	Age, Gender, Ethnicity, Income, Education	.04	.04	1.20
2	Mindfulness & Vulnerability to Relapse	.11	.07	5.18**
3	Interaction Term (Mindfulness x Vulnerability to Relapse)	.13	.02	3.55[a]

[a]approaches significance (p=.06), ***p*<.01. **p*<.05.

Table 25

Summary of Hierarchical Linear Regression Analysis with Coping (Brief COPE Planning Coping) as Criterion (*N*=128)

Step	Predictor Variable	R^2	ΔR^2	ΔF
1	Age, Gender, Ethnicity, Income, Education	.10	.10	3.10
2	Mindfulness & Vulnerability to Relapse	.16	.06	5.15**
3	Interaction Term (Mindfulness x Vulnerability to Relapse)	.18	.02	2.57

**p<.01. *p<.05.

Table 26

Summary of Hierarchical Linear Regression Analysis with Coping (Brief COPE Self-Blame Coping) as Criterion (N=144)

Step	Predictor Variable	R^2	ΔR^2	ΔF
1	Age, Gender, Ethnicity, Income, Education	.03	.03	0.85
2	Mindfulness & Vulnerability to Relapse	.13	.10	8.14**
3	Interaction Term (Mindfulness x Vulnerability to Relapse)	.13	.00	.00

**p<.01. *p<.05.

Table 27

Summary of Hierarchical Linear Regression Analysis for Mindfulness as a Moderator of the Relationship between Slip Frequency and AVE1 in Lapsers (*N*=65)

Step	Predictor Variable	R^2	ΔR^2	ΔF
1	Age, Gender, Ethnicity, Income, Education	.05	.02	.19
2	Mindfulness (MAAS) & Lapse	.08	.07	2.10
3	Interaction Term (Mindfulness x Lapse)	.10	.01	.78

***p*<.01. **p*<.05.

Table 28

Summary of Hierarchical Linear Regression Analysis for Mindfulness as a Moderator of the Relationship between Slip Frequency and AVE2 in Lapsers (*N*=65)

Step	Predictor Variable	R^2	ΔR^2	ΔF
1	Age, Gender, Ethnicity, Income, Education	.16	.16	2.23
2	Mindfulness (MAAS) & Lapse	.23	.07	2.73
3	Interaction Term (Mindfulness x Lapse)	.28	.05	3.69[a]

[a]approaches significance (p=.06). ***p*<.01. **p*<.05.

Table 29

Summary of Hierarchical Linear Regression Analysis for Mindfulness as a Moderator of the Relationship between Slip Frequency and AVE3 in Lapsers (*N*=70)

Step	Predictor Variable	R^2	ΔR^2	ΔF
1	Age, Gender, Ethnicity, Income, Education	.06	.06	.82
2	Mindfulness (MAAS) & Lapse	.17	.11	3.92*
3	Interaction Term (Mindfulness x Lapse)	.17	.01	.40

**p<.01. *p<.05.

Table 30

Causal Dimension Scale Instructions and Subscale Items

Please list the main reason why you have been successful or unsuccessful in meeting your exercise goal(s):_____Think about the reason(s) you have written above. The items below concern your impressions or opinions of this cause or causes of your performance. Circle one number for each of the following questions. Is the cause(s) something:

Internal Causation Anchors	
That reflects an aspect of yourself	Reflects an aspect of the situation
Inside of you	Outside of you
Something about you	Something about others
Stability of Cause Anchors	
Permanent	Temporary
Stable over time	Variable over time
Unchangeable	Changeable
Personal Control Anchors	
Manageable by you	Not manageable by you
You can regulate	You cannot regulate
Over which you have power	Over which you have no power
External Control Anchors	
Over which others have control	Over which others have no control
Under the power of other people	Not under the power of others
Other people can regulate	Other people cannot regulate

Table 31

Associations between Vulnerability to Relapse and Exercise Maintenance

	Vulnerability to Relapse
Slip Frequency	+
Lapse in past year	+
Relapse in past year	
Regular Exerciser	–
Adherent with CDC/ACSM Guidelines	–

Note. Blank cells are non-significant. + and - significant @ $p<.05$

Table 32

Associations between Coping and Exercise Maintenance

	Coping					
	ECT[a]	EPOC[b]	Brief COPE for Exercise			
			Emotional Support	Instrumental Support	Planning	Self-Blame
Slip Frequency					+	+
Lapse in past year					+	+
Relapse in past year					+	
Regular Exerciser						
Adherent with CDC/ACSM Guidelines						–

Note. Blank cells are non-significant. [a] Exercise Coping Task. [b] Exercise Processes of Change. + and - significant @ $p<.05$

Table 33

Associations between the Attributions component of the AVE and Exercise Maintenance

	Internal	Stable
Slip Frequency		–
Lapse in past year	–	–
Relapse in past year	–	–
Regular Exerciser	+	+
Adherent with CDC/ACSM Guidelines	+	+

Note. Blank cells are non-significant. + and - significant @ $p<.05$.

Table 34

Associations between the Perceived Control Components of the AVE and Exercise Maintenance

	Variables representing the Perceived Control Component of the AVE			
	Control while dropped out of exercise?	Personal Control	External Control	Demoralization Scale-Competence Subscale
Slip Frequency		–		–
Lapse in past year		–	+	–
Relapse in past year		–		
Regular Exerciser		+		+
Adherent with CDC/ACSM Guidelines		+		+

Note. Blank cells are non-significant. + and - significant @ $p<.05$.

Table 35

Associations between the Guilt Components of the AVE and Exercise Maintenance

	Variables representing the Guilt Component of the AVE		
	Dispositional Guilt (Personal Feelings Questionnaire)	Guilt while dropped out of exercise?	Demoralization Scale for Exercise - Distress Subscale
Slip Frequency		+	+
Lapse in past year	+ (p=.06)	+	+
Relapse in past year			+ (p=.06)
Regular Exerciser			–
Adherent with CDC/ACSM Guidelines			–

Note. Blank cells are non-significant. + and - significant @ p<.05.

Table 36

Associations between AVEs and Exercise Maintenance in Lapsers

	Abstinence Violation Effect		
	AVE1	AVE2	AVE3
Slip Frequency		–	+
Lapse in past year		–	+
Relapse in past year			
Regular Exerciser		+[a]	–
Adherent with CDC/ACSM Guidelines		+[b]	–[a]

Note. Blank cells are non-significant. [a]approaches significance, p=.06, [b]approaches significance, p=.07, + and - significant @ $p<.05$.

Table 37

Associations between Mindfulness and Exercise Maintenance

	Mindfulness
Slip Frequency	
Lapse in past year	_
Relapse in past year	
Regular Exerciser	
Adherent with CDC/ACSM Guidelines	

Note. Blank cells are non-significant. + and - significant @ $p<.05$.

FIGURES

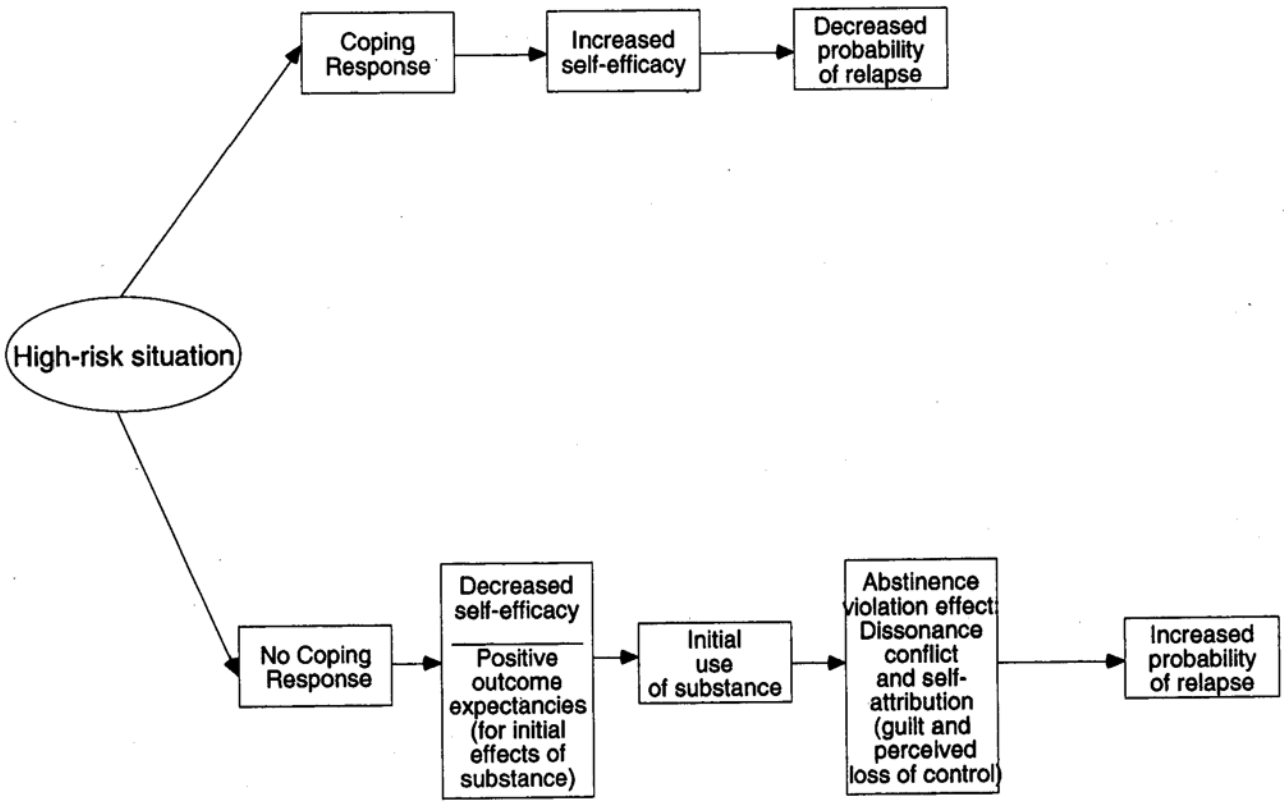


Figure 1. Relapse Prevention Model (Marlatt & Gordon, 1985)

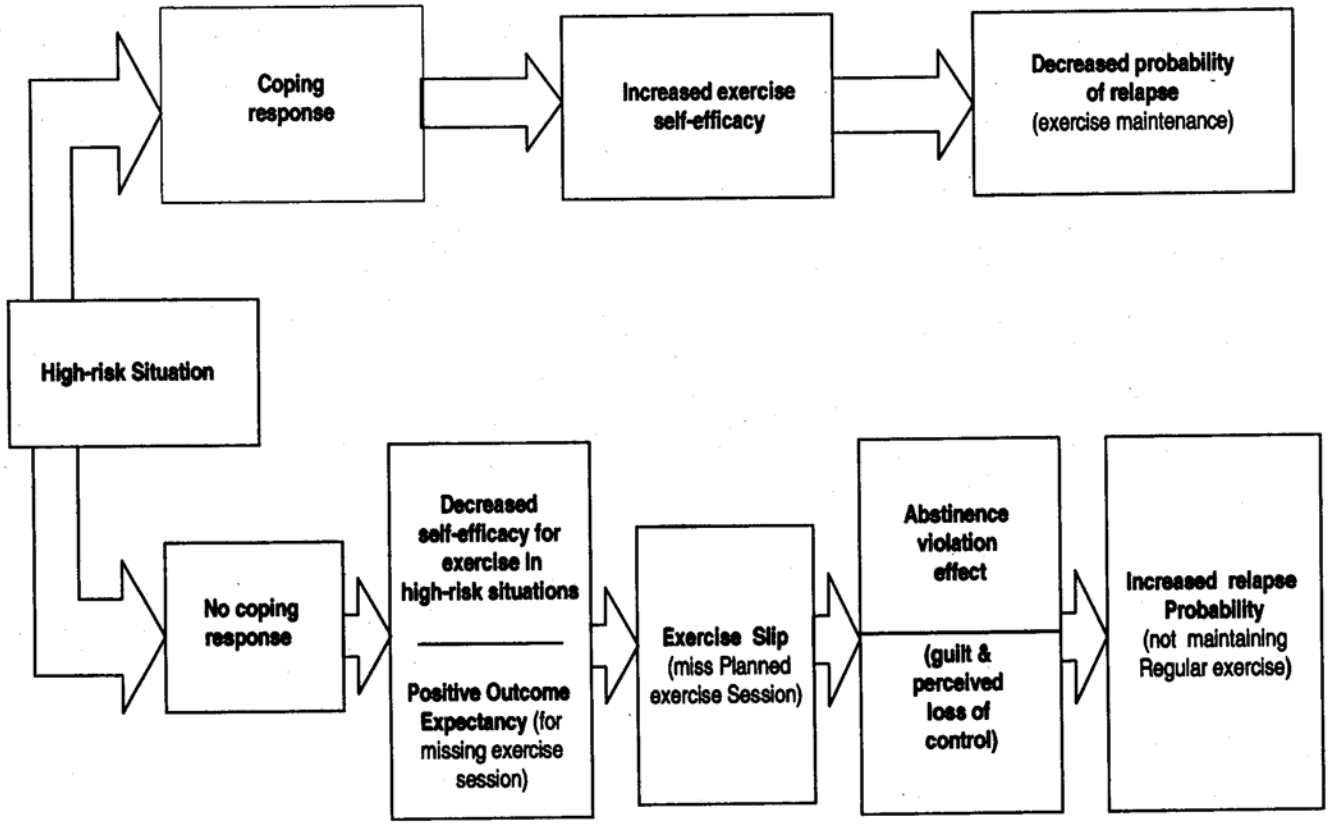


Figure 2. Relapse Prevention Model for Exercise (Stetson, et al, 2004)

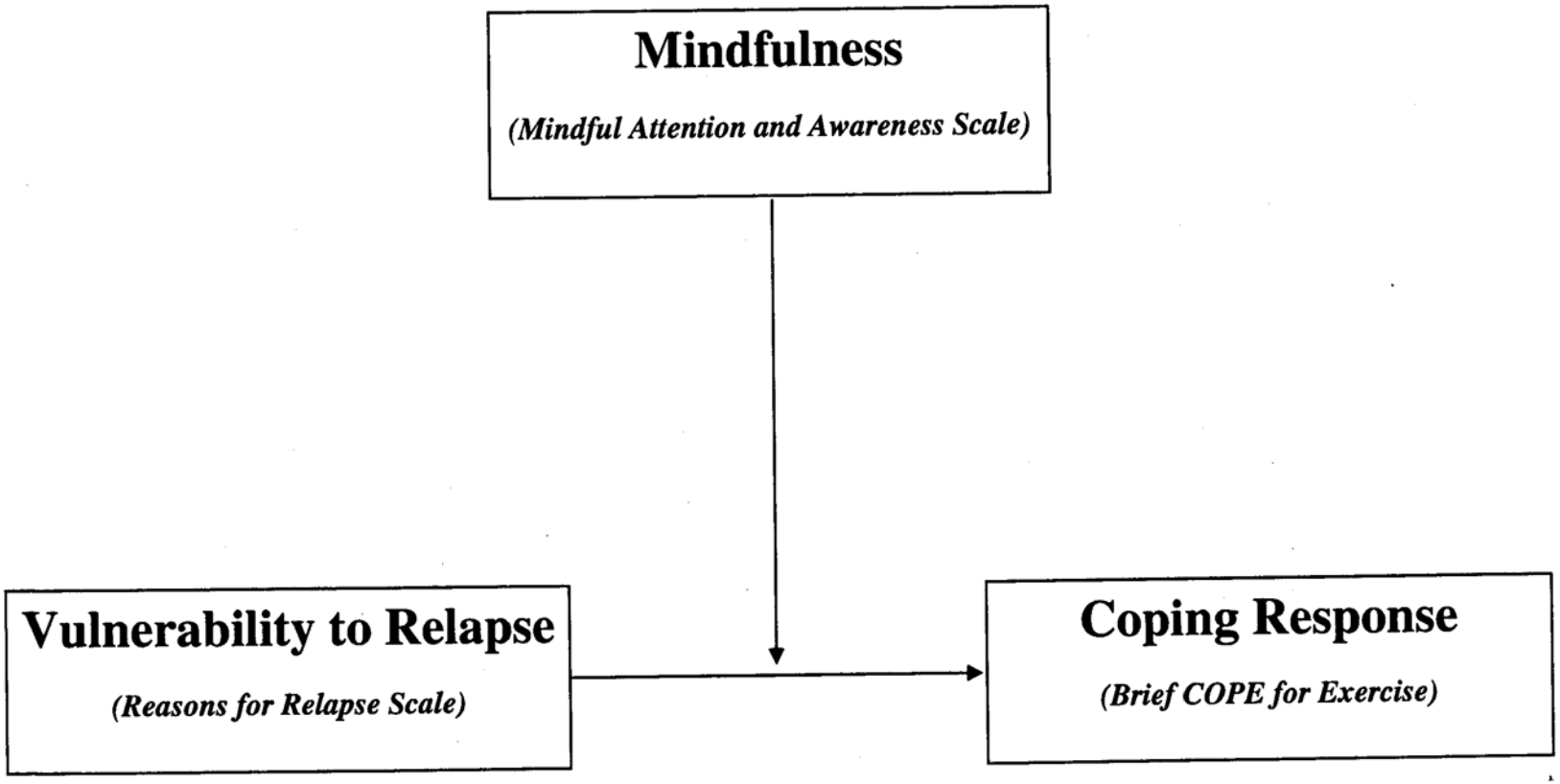


Figure 3. Hypothesis 1: Mindfulness Moderates the Relationship between Vulnerability to Relapse and Coping

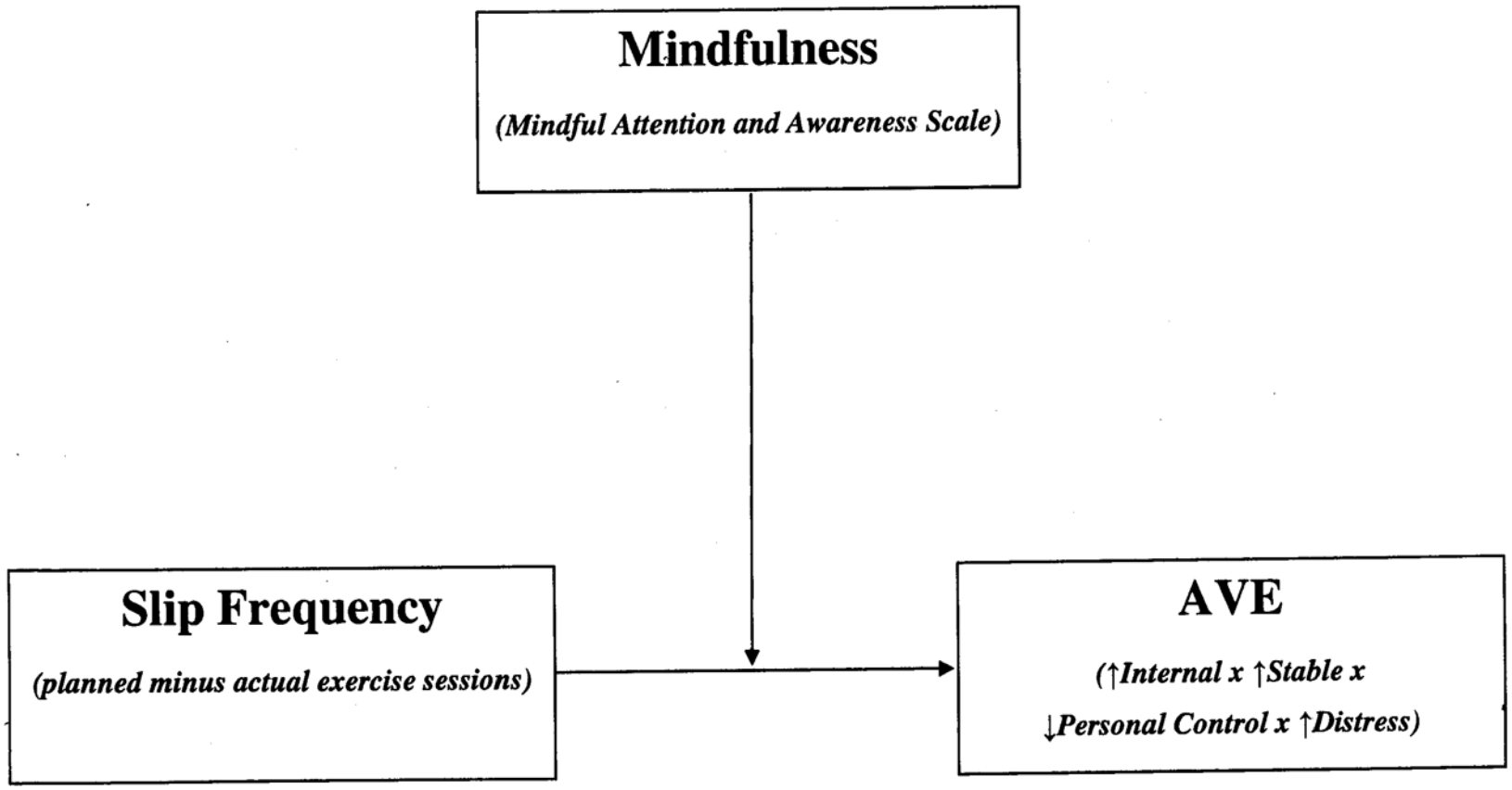
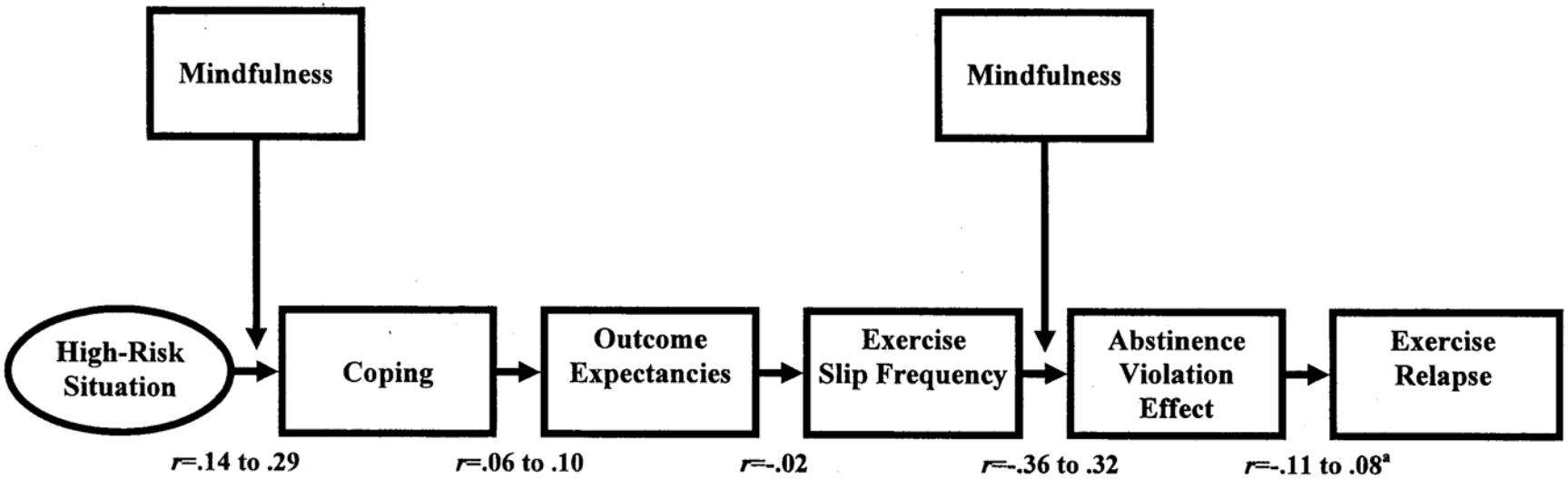


Figure 4. Hypothesis 2: Mindfulness Moderates the Relationship between Slip Frequency and AVE in Lapsers



	Vulnerability to Relapse	Outcome Expectancies
Emotional Support Coping	r=.14	r=.10
Instrumental Support Coping:	r=.21**	r=.06
Planning Coping:	r=.29**	r=.08
Self-Blame Coping:	r=.23**	r=.09

	Exercise Slip Frequency	Exercise Relapse
AVE1	r=.12	r=.04
AVE2	r=-.36**	R=-.11
AVE3	r=.32**	r=.08

Figure 5. Statistical Model Depicting Pearson Correlations between Relapse Prevention Model Constructs and the Hypothesized Moderating Effect of Mindfulness. [a] dummy-coded Relapse variable used to obtain Pearson correlation, **p<.01, *p<.05.

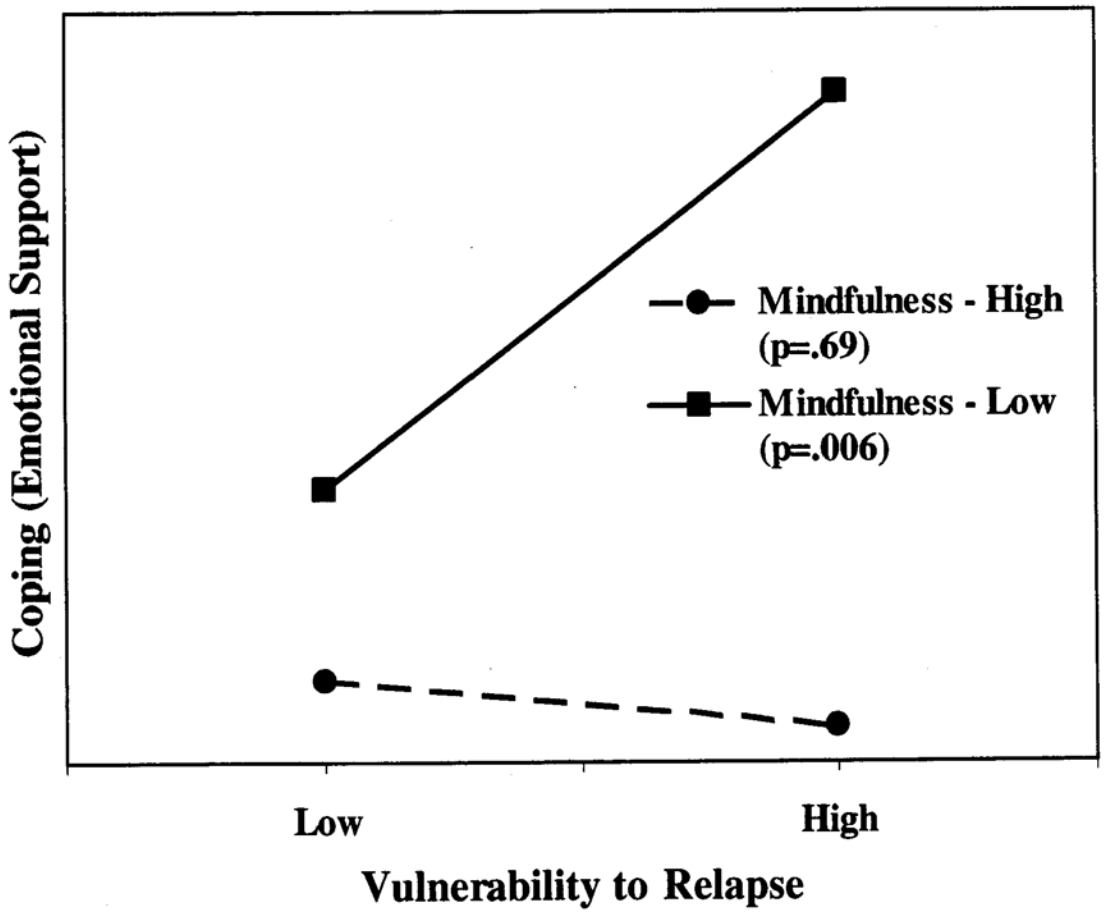


Figure 6. Mindfulness Moderates the Relationship between Vulnerability to Relapse and Emotional Support Coping (p=.01).

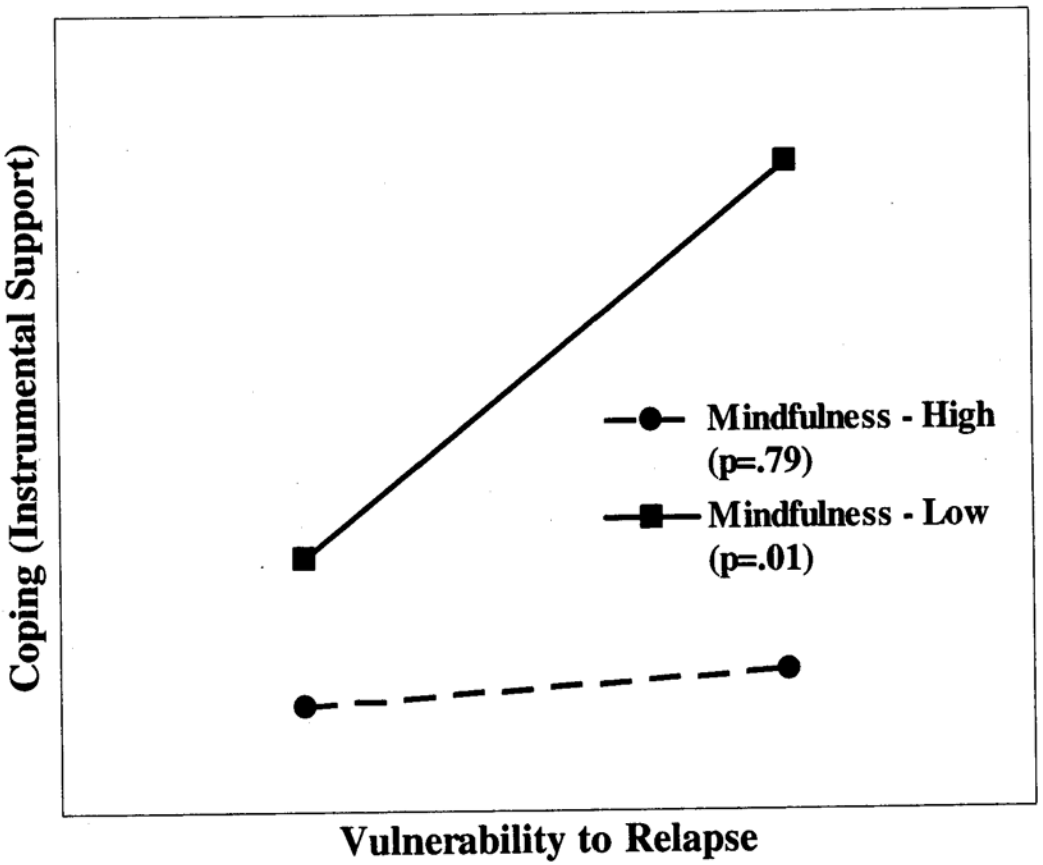


Figure 7. Mindfulness approaches significance for moderating the Relationship between Vulnerability to Relapse and Instrumental Support Coping (p=.06).

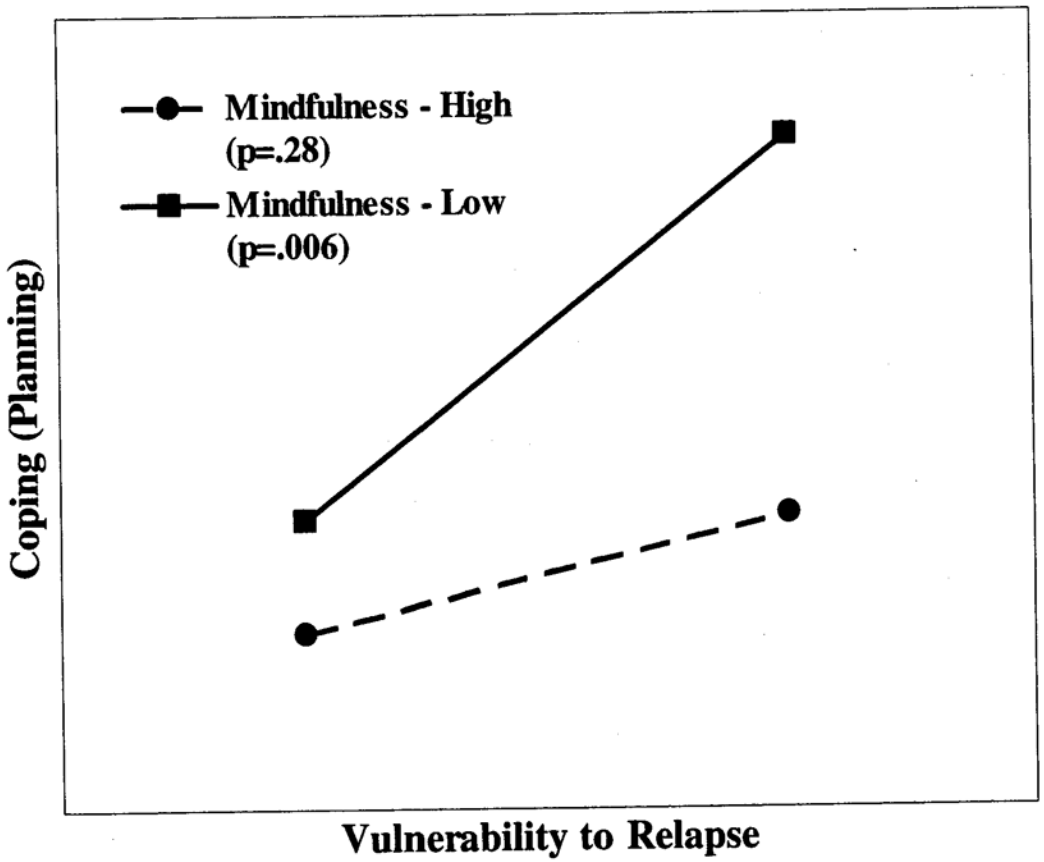


Figure 8. Mindfulness does not Moderate the Relationship between Vulnerability to Relapse and Planning Coping (p=.11).

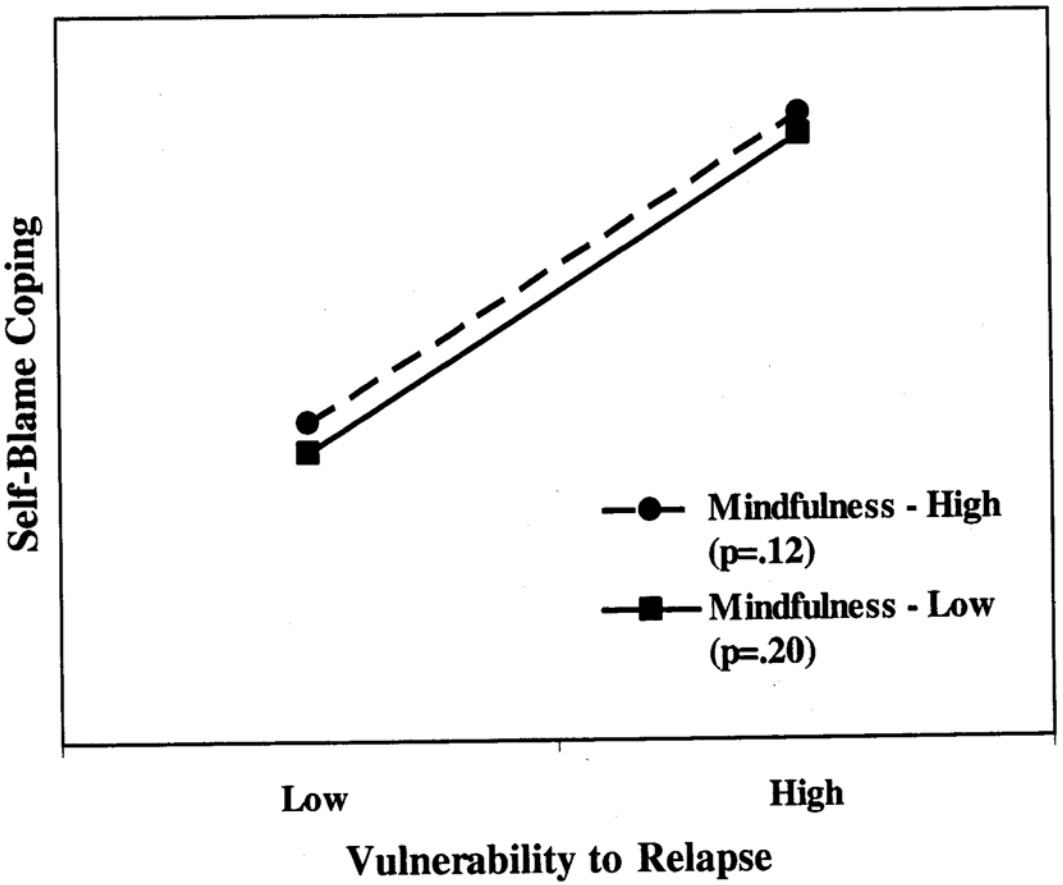


Figure 9. Mindfulness does not moderate the Relationship between Vulnerability to Relapse and Self-Blame Coping (p=.98)

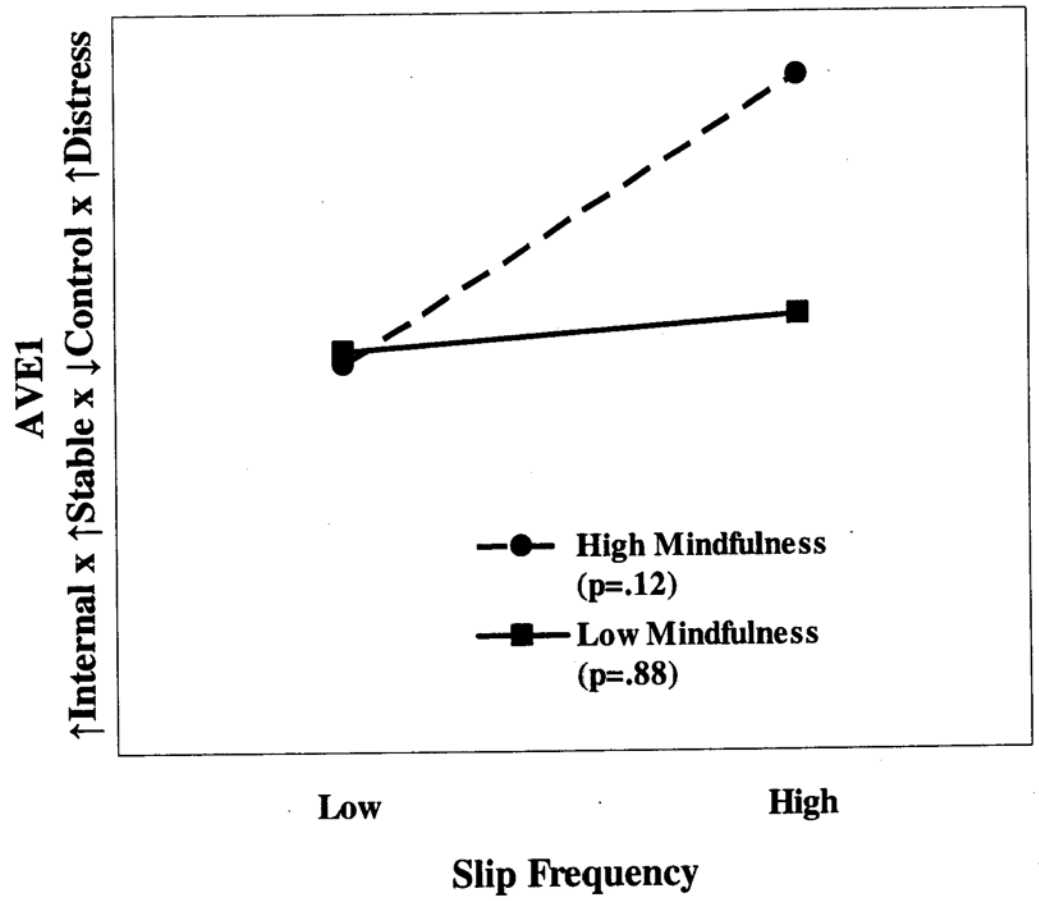


Figure 10. Mindfulness does not moderate the Relationship between Slip Frequency and AVE1 in Lapsers (p=.38).

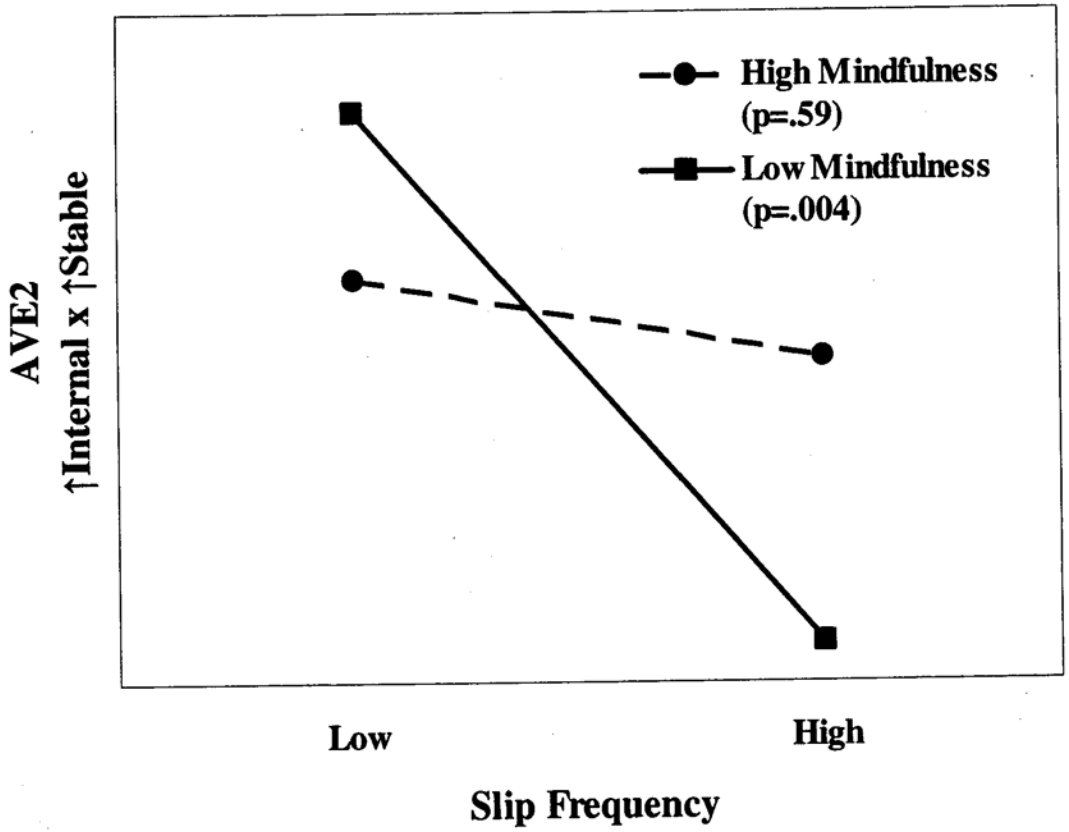


Figure 11. Mindfulness approaches significance for moderating the Relationship between Slips and AVE2 in Lapsers (p=.06).

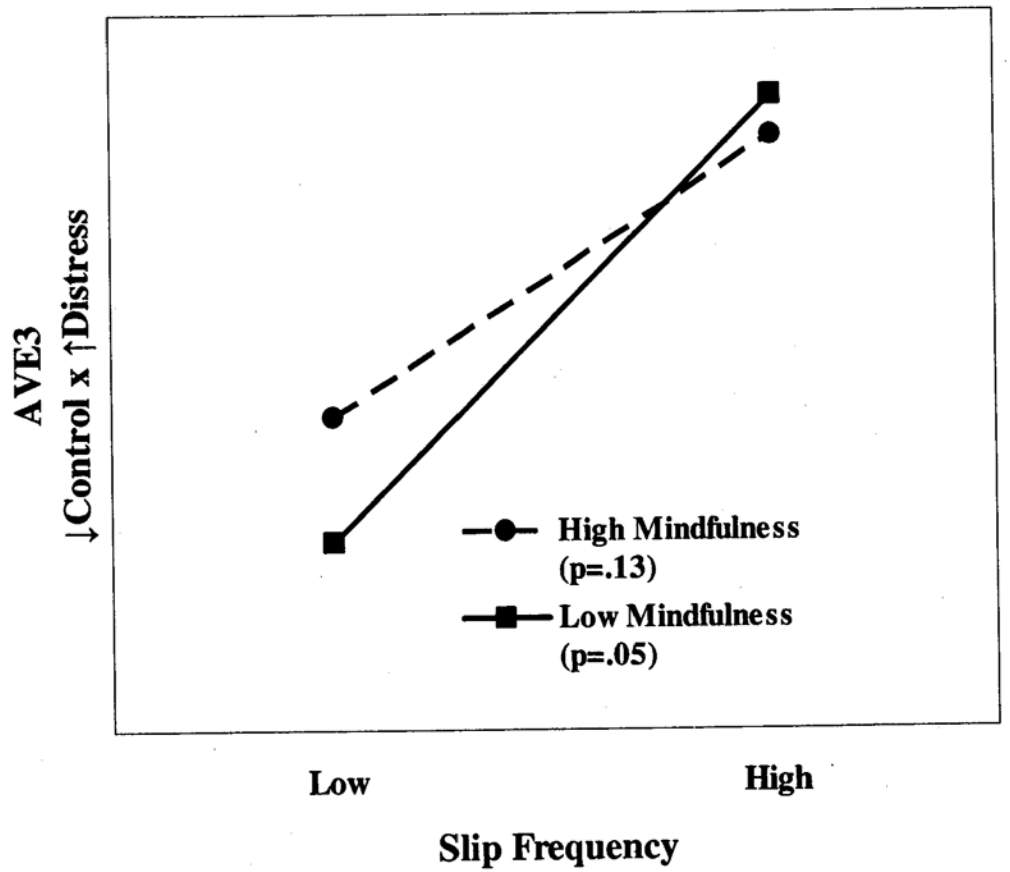
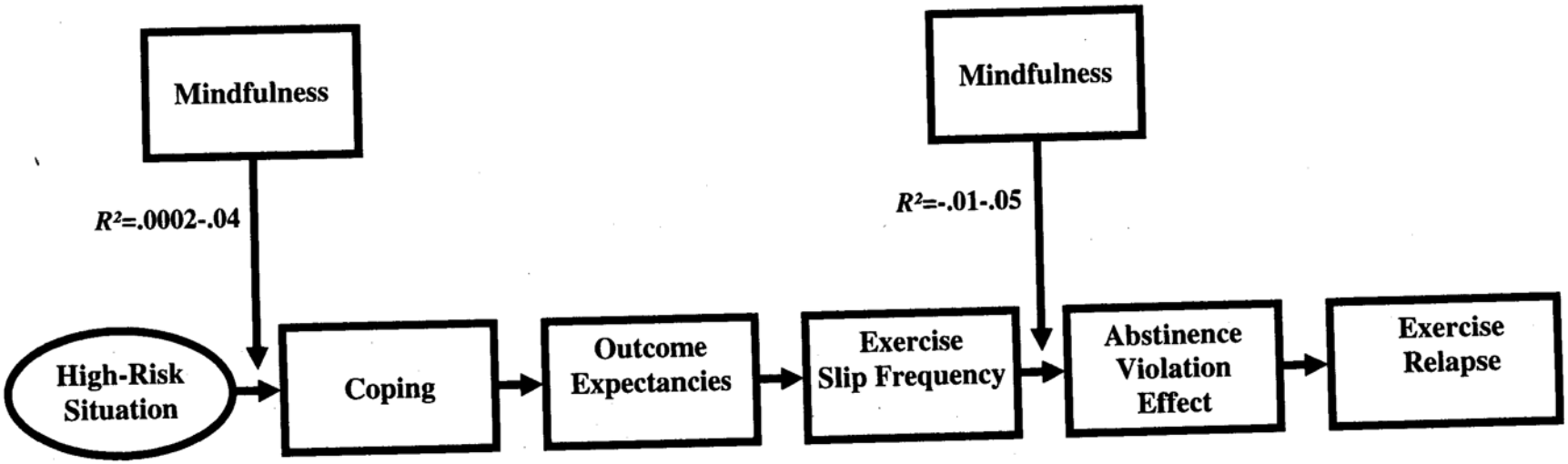


Figure 12. Mindfulness does not moderate the Relationship between Slip Frequency and AVE3 in Lapsers (p=.53).



Dependent Variable	Mindfulness
Emotional Support Coping	R^2=.04*
Instrumental Support Coping:	R^2=.02[a]
Planning Coping:	R^2=.02
Self-Blame Coping:	R^2=.0002

Dependent Variable	Mindfulness
AVE1	R^2=.01
AVE2	R^2=.05[a]
AVE3	R^2=.01

Figure 13. Collapsed Relapse Prevention Model Depicting Mindfulness as a Moderator of RPM Relationships and Variance Explained (R^2 values) by the Interaction of Mindfulness and Predictor Variables. [a] approaches significance (p=.06), **p<.01, *p<.05.

CURRICULUM VITAE

NAME:	Christi S. Ulmer
CONTACT INFORMATION:	VA Medical Center 508 Fulton St. Durham, NC, 27705
DOB:	Louisville, Kentucky – March 22, 1964

Ph.D. November, 2006	University of Louisville, Clinical Psychology, Dissertation: *Mindfulness as a Moderator of Coping Response and the Abstinence Violation Effect: A Test of the Role of Mindfulness in the Relapse Prevention Model for Exercise*
Clinical Psychology Internship *9/1/2005-8/31/2006*	Palo Alto Veterans Affairs Healthcare System, Palo Alto, CA Specialty Track: *Behavioral Medicine*
M.A. *8/6/2004*	University of Louisville, Clinical Psychology, Preliminary Examinations Topic: *A Randomized Controlled Trial of a Mindfulness-Based Intervention for Type 2 Diabetes Mellitus*
Post-Baccalaureate Course Work *1/1999-12/2000*	Georgia State University, Psychology, Honors Thesis*: Memory Narrative Specificity and Early Maladaptive Schemas*
B.S. *12/17/1988*	University of Louisville, Geology

RESEARCH AND CLINICAL INTERESTS

Behavioral Medicine and Clinical Psychology in Medical Settings, Behavioral Sleep Medicine, Integrated Primary Care, Health Behavior Change, Mindfulness, and Acceptance and Commitment Therapy (ACT)

PUBLICATIONS

Journal Articles

Sephton, S., Salmon, P., Weissbecker, I., Ulmer, C., Hoover, K., & Studts, J. The Impact of a Mindfulness-Based Stress Reduction Program on Depressive-spectrum Symptoms in Women with Fibromyalgia: A Prospective Study. *Arthritis Care and Research,* (in press).

Salmon, P., Sephton, S., Weissbecker, I., Hoover, K., Ulmer, C., & Studts, J. (2004). Mindfulness meditation in clinical practice. *Cognitive and Behavioral Practice, 11, 434-446.*

Riso, L.P., duToit, P.L., Blandino, J.A., Penna, S., Dacey, S., Duin, J.S., Pacoe, E.M., Grant, M.M., & Ulmer, C.S. (2003). Cognitive aspects of chronic depression. *Journal of Abnormal Psychology, 112*, 72-80.

Crawford, N., & Ulmer, C. (1994). Hydrogeologic investigations of contaminant movement in karst aquifers in the vicinity of a train derailment near Lewisburg, Tennessee. *Journal of Environmental Geology*, 23, 41-52.

Crawford, N., & Ulmer, C. (1993). Groundwater investigations to determine contaminant movement in the karst aquifers in the vicinity of a train derailment near Lewisburg, Tennessee. In Beck, B. F. (Ed.), *Applied Karst Geology* (pp.79-87). Rotterdam, Netherlands: A. A. Balkema Publishers

Manuscripts in Preparation

Ulmer, C., Stetson, B., Salmon, P., & Sephton, S. *Evaluation of the Levels of Evidence for the Effects of Meditation on Physiological and Health Outcomes.* Resubmission pending.

Stetson, B., Ulmer, C., Meyer, J., Beacham, A., Dubbert, P. *Exercise lapses and relapse in regular exercisers: Perceived and behavioral patterns and prospective associations in community women.*

Bonner, J., Buckley, A., Ulmer, C., Mitchell, C., Newton, T., & Woodruff-Borden, J. *Differences in Perceived Health Status among Depressed, Sub-Clinically Depressed, and Non-Depressed Chronically-Ill Patients within a Medically-Underserved Primary Care Population.*

Published Abstracts

Bonner, J., Stetson, B., Beacham, A., Ulmer, C., Rothschild, C., & Meyer, J. (2006). Associations between exercise schema and exercise behavior related to psychological well-being in community dwelling adults. *Annals of Behavioral Medicine, (Suppl.)*

Stetson, B., Beacham, A., Meyer, J., Ulmer, C., Rothschild, C., & Bonner, J. (2005). Exercise cognitions differ by number of exercise relapse occurrences. *Annals of Behavioral Medicine, 29, (Suppl.), S160*.

Stetson, B., Beacham, A., Rothschild, C., Bonner, J., & Ulmer, C. (2005). Combined utility of the Transtheoretical/Stage of Change and Relapse Prevention Models in understanding the process of ongoing exercise change. *Annals of Behavioral Medicine, 29, (Suppl.),S159.*

Ulmer, C., Stetson, B., Beacham, A., Newton, T., Mitchell, C., and Woodruff-Borden, J. (2004). Obesity, health perceptions and risk reduction information seeking in a medically underserved primary care population. *Annals of Behavioral Medicine, 27, (Suppl.),*
S132.

Stetson, B., Beacham, A., Dubbert, P., Ulmer, C., and Meyer, J. (2004). Community exercisers' perspectives on processes of exercise lapse and relapse. Citation Award Recipient, SBM Annual Conference, *Annals of Behavioral Medicine, 27, (Suppl.),* S041.

Ulmer, C., Weissbecker, I., Sephton, S., Studts, J., Banis, P., McGuffin, S., Hoover, K., & Salmon, P. (2002). Demographic Factors do not predict adherence or outcome in a Mindfulness-Based Stress Reduction (MBSR) program for women with Fibromyalgia. *Annals of Behavioral Medicine, 24 (Suppl. 2)*, S034.

Dedert, E., Banis, P., Weissbecker, I., Studts, J., Salmon, P., McGuffin, S., Hoover, K., Ulmer, C., Segerstrom, S., Dhabhar, F., and Sephton, S. (2002). Spiritual expression is linked with endocrine and immune function among women with Fibromyalgia. *Annals of Behavioral Medicine, 24 (Suppl. 2),* S080.

CONFERENCE PRESENTATIONS

Ulmer, C., Stetson, B., Beacham, A. O., Cartwright, A., & Hincker, P. (2006, November). *Acceptance-Based Constructs and Exercise Maintenance*. Presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, 2006, Chicago, IL.

Meyer, J., Stetson, B., Bonner, J., Rothschild, C., Ulmer, C., & Beacham, A. (2006, November). *Demoralization and affective state and associations with exercise characteristics in a sample of community exercisers.* Presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, 2006, Chicago, IL.

Ulmer, C., Walser, R., Westrup, D., Rogers, D., Gregg, J., & Loew, D. (2006, July) *Acceptance and Commitment Therapy: Adaptation of a structured intervention for the treatment of PTSD.* Presented at the Second World Conference on ACT, RFT, and Contextual Behavioural Science in London, England.

Walser, R., Westrup, D., Gregg, J., Loew, D., Rogers, D. & Ulmer, C. (2006, July) *ACT for men and women in the treatment of military trauma*. Presented at the Second World Conference on ACT, RFT, and Contextual Behavioural Science in London, England.

Ulmer, C. (2005, April) *The Effects of MBSR and Meditation on Physiological and Health Outcomes: A Levels of Evidence Assessment.* Research forum presented at the Integrating Mindfulness-Based Interventions into Medicine, Health Care, and Society: 3rd Annual Conference for Clinicians, Researchers, and Educators, Worcester, Massachusetts.

Beacham, A., Ulmer, C., & Stetson, B. (November, 2005) *Exercise Attitude, Decisional Balance and Behavioral Intervention in a Sample of Midlife and Older Women with Elevated Cardiovascular Risk*. Poster presented at the Annual Meeting of the Association for Behavioral and Cognitive Therapy.

Bonner, J., Ulmer, C., Buckley, A., Mitchell, C., Newton, T., & Woodruff-Borden, J. (November, 2005) *Differences in Perceived Health Status among Depressed, Sub-Clinically Depressed, and Non-Depressed Chronically-Ill Patients within a Medically-Underserved Primary Care Population.* Poster presented at the Annual Meeting of the Association for Behavioral and Cognitive Therapy.

Meyer, J., Stetson, B., Ulmer, C., Dubbert, P. (November, 2005) *Association of Tonic Processes and Exercise Relapse in Male Community Exercisers.* Poster presented at the Annual Meeting of the Association for Behavioral and Cognitive Therapy.

Stetson, B., Bonner, J., Meyer, J., Ulmer, C., Rothschild, C. Kurian, R., & Mokshagundam, S. (November, 2005) *Home-based Physical Activity Behaviors in Older Men with Diabetic Neuropathy following Cessation of Supervised Resistance Training.* Poster presented at the Annual Meeting of the Association for Behavioral and Cognitive Therapy

Ulmer, C., Stetson, B., Beacham, A., Salmon, P., & Meyer, J. (November, 2004) *Trait mindfulness in a sample of community exercisers.* Poster presented at the annual meeting of the Association for the Advancement of Behavior Therapy, New Orleans, Louisiana.

Stetson, B., Beacham, A., Meyer, J., Bonner, J., Ulmer, C., & Rothschild, C. (November, 2004) *Consistency of physical activity patterns and relationship to mood in community dwelling adults.* Poster presented at the annual meeting of the Association for the Advancement of Behavior Therapy, New Orleans, Louisiana.

Ulmer, C., Weissbecker, I. and McGuffin, S. (April, 2002) *The Effects of a Meditation Program on Symptoms of Illness and Neuroendocrine Responses in Women with Fibromyalgia*. Invited presentation to medical providers at Baptist East Hospital, in Louisville, Kentucky.

Salsman, N., Ulmer, C., & Murrell, S. (March, 2002) *Time-limited interpersonal therapy interventions and outcomes*. Poster presented at the Annual Meeting of the American Psychological Association, Chicago, IL.

Ulmer, C., Riso, L., Blandino, J., & Penna, S. (November, 2000) *Memory narrative specificity and early maladaptive schemas.* Poster presented at the Annual Meeting of the Association for the Advancement of Behavior Therapy, New Orleans, LA.

Wood, K., Stovall, Erika, Wooten, J., & Ulmer, C. (March, 2000) *Public-sector consumers' use of brief outpatient mental health services.* Poster presented at the Annual Meeting of the American Psychological Association, Washington, DC.

Crawford, N., & Ulmer, C. (1993) *Groundwater investigations to determine contaminant movement in the karst aquifers in the vicinity of a train derailment near Lewisburg, Tennessee*. Paper presented at the Fourth Multi-Disciplinary International Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, Panama City, Florida.

Carr, L., Ulmer, C., & Eger, C. (1990) *Delineation of a suspected drum and hazardous waste disposal site utilizing multiple geophysical methods, Shaver's farm, Chickamauga, Walker County, Georgia.* Paper presented at the Annual Meeting of the Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods, Las Vegas, NV.

CLINICAL EXPERIENCE

2005-2006 Clinical Psychology Intern, Veterans Affairs Palo Alto Health Care System, Palo Alto, California. Rotations in Behavioral Medicine, Cardiac Psychology, National Center for PTSD, and Acceptance and Commitment Therapy. Training

was based upon a scientist-practitioner model and designed to provide knowledge of empirically-based assessment and intervention methods in an interdisciplinary medical setting. Specialty training in Pain, Oncology, and Primary Care clinics, and at the National Center for PTSD.

2004-2005 Graduate Student Therapist, Geriatric Home-Based Primary Care Team, Veterans Affairs Louisville, Kentucky. Team members were trained in empirically-based management of chronic disease and prevention and risk reduction as part of an inter-disciplinary home-based primary care geriatrics team.

2003-2004 Graduate Student Therapist, Behavioral Primary Care Team, University of Louisville Ambulatory Internal Medicine Clinic, Kentucky. Provided brief behavioral medicine interventions and psychological assessments for a medically underserved primary care population.

2003-2004 Graduate Student Psychometrist, Private Practice Practicum, Louisville, Kentucky. Assessment of disability claimants for neuropsychological and functional impairment secondary to a variety of mental and physical conditions.

2002-2003 Graduate Student Therapist, Central State Hospital Acute Care Unit, Louisville, Kentucky. Duties included interviewing, assessment, individual and group therapy, and testing of severely mentally ill inpatients at a state-funded facility.

2001-2002 Graduate Student Therapist, Psychological Services Center, University of Louisville, Kentucky. Provided outpatient therapy and assessment to women presenting with PTSD using cognitive-behavioral therapy treatment protocols.

2001-2005 Graduate Student Therapist, Psychological Services Center, University of Louisville, Kentucky. Conducted psychodiagnostic assessments and clinical intakes of adults, and intellectual functioning assessment of children.

1999- Research Assistant, Grady Hospital, Emory University School of Medicine, Atlanta, Georgia. Conducted cognitive, psychodiagnostic and functional assessments of individuals with Schizophrenia Spectrum Disorders in a Milieu setting.

RESEARCH EXPERIENCE

2003-2005 Health Behavior Change Research Lab, Team Member, Department of Psychological and Brain Sciences, University of Louisville, Louisville, Kentucky, Supervisor: Barbara Stetson, PhD.

2001-2003 BioBehavioral Medicine Research Group, Team Member, University of Louisville School of Medicine, Department of Oncology, and Department of Psychological and Brain Sciences, Louisville, Kentucky. Supervisors: Paul Salmon, PhD, Sandra Sephton, PhD, and Jamie Studts, PhD.

2002-2003 Severely Mentally Ill Empirically Validated Treatment Group Development Team, Team Member, Central State Hospital, Louisville, Kentucky. Supervisor: Paul Bock, PhD.

1999-2000 Evaluation and Brief Treatment Services, Research Assistant, Grady Memorial Hospital, Emory University School of Medicine, Atlanta, Georgia. Supervisor: Erika Stovall, PhD.

2000 Grady Health System Adult Day Treatment Program, Emory University School of Medicine, Atlanta, Georgia. Supervisor: Susan Reviere, PhD.

2000 Honors Research Project, Memory Narrative Specificity and Early Maladaptive Schemas, Department of Psychology, Georgia State University, Atlanta, Georgia. Supervisor: Lawrence Riso, PhD.

1999-2001 Cognitive Theories of Depression Laboratory, Research Assistant, Georgia State University, Atlanta, Georgia. Supervisor: Lawrence Riso, PhD.

1986-1988 Undergraduate Research Assistant, Stone Preservation Study, Department of Geology, University of Louisville, Louisville, Kentucky. Supervisor: K. Lai Gauri, PhD.

AWARDS AND HONORS

Grawemeyer Graduate Student Research Fellowship, 2004-2005 stipend
Grawemeyer Summer Research Awards, 2002-2004
1st Place Hager Award, Kentucky Psychological Association Conference, 2003
Golden Key National Honors Society, 2000
Georgia State University Honors Program, 2000
Bronze Medal-US Environmental Protection Agency, Hurricane Andrew Response, 1991
Bronze Medal-US Environmental Protection Agency, Florida DOT Settlement, 1995
Outstanding Senior Geology Student Award, 1988
KYANA Geological Society Scholarship, 1988

PROFESSIONAL MEMBERSHIPS

Society for Behavioral Medicine
Association for Behavioral and Cognitive Therapy
Association for Contextual Behavioral Science

TEACHING EXPERIENCE

2001-2004 *Introduction to Psychology*, Teaching Assistant, University of Louisville, Louisville, Kentucky, Administration of exams and course management for more than 700 students per semester.

2001-2004 *Introduction to Psychology*, Lab Instructor, University of Louisville, Louisville, Kentucky, Lecturing and Laboratory Experiments, Modules included: Neuroscience; Sensation and Perception; Learning, Memory; Lifespan Development; Personality; Social Psychology; Psychological Disorders and Therapies.

1987-1988 Student Athlete Tutor, Math and Science Courses, University of Louisville

EMPLOYMENT HISTORY

1990-2001 United States Environmental Protection Agency, Atlanta, Georgia
Senior Remedial Project Officer, Environmental Enforcement Officer, and On-Scene Coordinator

1988-1990 C.C. Johnson & Malhotra, P.C., Atlanta, Georgia,
Technical Assistance Team Member

SELECTED PROFESSIONAL TRAINING

2006 *Beyond Stimulus Control: How to Translate State-of-the-Art Research Into Effective Clinical Management of Insomnia*, Charles M. Morin, Ph.D. & Jack D. Edinger, Ph.D. Workshop presented at the annual meeting of the Association for Behavioral and Cognitive Therapy (ABCT).

2005 *Sleep Disorders: Assessment and Treatment*, Tracy Kuo, Ph.D., Stanford Sleep Disorders Clinic, VA Palo Alto Health Care System, Palo Alto, CA

2005 *The Principles and Practice of Behavioral Sleep Medicine*, Ryan Wetzler, Psy.D., Spalding University, Louisville, KY.

2005 *Acceptance and Commitment Therapy (ACT) Pre-Institute Experiential Workshop*, Steven Hayes, PhD., La Salle University, Philadelphia, PA.

2005 *Acceptance and Commitment Therapy (ACT) Summer Institute*, La Salle University, Philadelphia, PA.

2004 *The A, B, Z's of DBT: Dialectical Behavior Therapy Basics and Beyond*, Marsha M. Linehan, Ph.D. & Kathryn E. Korslund. Workshop presented at the Association for the Advancement of Behavior Therapy Annual Meeting.

2004 *An Introduction to Assessment and Treatment of Chronic Pain*, Abbie O. Beacham, Ph.D., University of Louisville, Louisville, KY.

2004 *The Use of Meditation Techniques in Behavioral Medicine: Theory, Research, and Practice*, Jean Kristeller, PhD. & Ruth Quillian-Wolever, PhD., Society for Behavioral Medicine, Baltimore, MD.

2003 *Mindfulness-Based Stress Reduction: Growing Our Practice, Refining Our Skills, Embodying Our Understanding, and Situating Our Work*, Jon Kabat-Zinn, PhD., First Annual Conference, Integrating Mindfulness into Medicine, Health Care, and Society, Worcester, MA.

2003 *Articulated Silence: Refining Inquiry and Dialogue in the Mindfulness-Based Stress Reduction Classroom*, Saki Santorelli, PhD., First Annual Conference, Integrating Mindfulness into Medicine, Health Care, and Society, Worcester, MA.

2002 *Mindfulness-Based Stress Reduction in Mind-Body Medicine: 7-Day Professional Training*, The Center for Mindfulness in Medicine, Health Care, and Society, University of Massachusetts, Sponsored by the Omega Institute, Rhinebeck, NY.

1997 *Seven Habits of Highly Effective People*, U.S. EPA, Atlanta, GA

1995 *Listening*, Innovative Pathways, Atlanta, GA

1995 *Learning from Conflict*, Innovative Pathways, Atlanta, GA

1995 *Nine Traits of Highly Successful Teams*, Career Tracks, Atlanta, GA

1992 *Time Management Training*, Franklin International Institute, Atlanta, GA