

**DAILY MINDFULNESS, STRESS REACTIVITY, AND THE IMPACT ON  
DAILY HEALTH BEHAVIORS AND EMOTIONAL WELL-BEING**

by

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A thesis submitted to the Faculty of the University of Delaware in partial  
fulfillment of the requirements for the degree of Master of Arts in Psychology

Spring 2013

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## **ACKNOWLEDGMENTS**

I would like to thank my advisor, Dr. Jean-Philippe Laurenceau, for his guidance and thoughtful advice throughout this project. I am also appreciative for the support of Brendt Parrish, Stefanie LoSavio, Elizabeth Pasipanodya, and Amy Otto, fellow graduate student members of my lab. Finally, I am thankful for the amazing support and encouragement of my husband Andrew and my parents. I could not do this without you, and I am forever grateful for all that you do.

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## **ABSTRACT**

Using a daily diary methodology, we assessed the influence of daily (state) mindfulness on daily health behaviors, emotional well-being, and reactivity to negative events. Undergraduates completed nightly surveys for seven consecutive days reporting on their mindfulness, affect, daily events, and health behaviors (i.e., eating, exercise, and sleep). Results indicated that mindfulness (using the Five-Factor Mindfulness Questionnaire, or FFMQ) demonstrated both within- and between- person variability. Moreover, there were significant associations between daily mindfulness and daily health and emotional well-being, such that on days when an individual reported being more mindful, they also reported higher levels of some positive health behaviors and higher levels of emotional well-being. Surprisingly, daily mindfulness was not found to impact stress reactivity on a daily level. To our knowledge this study is the first to assess state mindfulness using the full FFMQ, and to examine associations between state mindfulness, daily health behaviors, and stress reactivity.

## **Chapter 1**

### **INTRODUCION**

Daily health behaviors such as proper diet, sleep, and exercise are integral to healthy psychological and physiological functioning. Positive health behaviors have been linked to well-being (Grant, Wardle, & Steptoe, 2009). There is considerable evidence that poor health behaviors, such as lack of physical exercise, unhealthy diet, and poor sleep habits are linked to negative affect and other negative psychosocial indicators (e.g., Crow, Eisenberg, Story, & Neumark-Sztainer, 2006; Gershon et al., 2012; Gilmore & Williams, 2011; Mata, Hogon, Joormann, Waugh, & Gotlib, 2012; Wong et al., 2012). Clinically, positive health behaviors may serve as important stabilizing factors for an individual prior to initiating the potentially destabilizing process of change within therapy (A. M. Hayes & Feldman, 2004). Negative health behaviors are also linked to long term physical health problems such as cancer, cardiovascular disease, and diabetes (Chiuve, McCullough, Sachs, & Rimm, 2006; Woolf, 2008). Specifically, negative health behaviors such as poor diet and exercise account for approximately 40% of mortality in industrialized countries (Kushi et al., 2006). Stress negatively impacts health behaviors in meaningful ways, including increases in stress which result in decreases in sleep quality and increases in unhealthy



eating behaviors (e.g., Giesermann, Ophey, de Jong-Meyer, & Pietrowsky, 2012; Kiecolt-Glaser, 2010; Minkel et al., 2012).

Because stress negatively impacts health behaviors, which are foundational to overall health and well-being, it is important to consider ways to ameliorate the negative effects of stress in an effort to promote health. Emerging research into the components and functions of mindfulness provides a potential avenue for considering the relationship between stress and health behaviors, as a strong inverse correlation between mindfulness and stress has been found (Carmody, Crawford, & Churchill, 2006). As mindfulness is also strongly correlated with affect, the impact of mindfulness on stress-reactivity may be key.

Mindfulness can be defined as “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment” (Kabat-Zinn, 2003). The construct of mindfulness has received significant empirical attention over the past 10 years, largely because of its salutary effects on stress, as evidenced by the widely researched mindfulness-based stress reduction intervention (MBSR, Kabat-Zinn, 1982). A mindful approach to coping with day-to-day stressful events has also been linked to increases in positive affect, decreases in negative affect, and increases in overall well-being.

Most of the research to date has focused on mindfulness within the context of interventions such as MBSR (Kabat-Zinn, 1982), mindfulness-based cognitive therapy (MBCT, Segal, Williams, & Teasdale, 2002), acceptance and commitment therapy

(ACT, S. C. Hayes, Strosahl, & Wilson, 1999), and dialectical behavior therapy (DBT, Linehan, 1993a, 1993b). Considerable evidence has been gathered for the benefits of mindfulness training in both medical and psychiatric populations (Baer, 2003; Grossman et al. 2004). However, a recent area of research into dispositional mindfulness, or the levels of mindfulness with which individuals approach everyday situations without formal training or practice, has found this trait to be predictive of several measures of well-being (Brown & Ryan, 2003). While there has been a growing level of research into dispositional mindfulness (also referred to as trait mindfulness), less research has been conducted on the ways in which mindfulness varies within a person over time. Investigating state measures of mindfulness may help identify the processes by which mindfulness and well-being are connected, specifically the connection between mindfulness and health behaviors. One notable study revealed both significant between- and within-person associations between mindfulness and well-being (Brown & Ryan, 2003). However, there have been few studies involving state measurements of mindfulness, and those studies that have measured state mindfulness in the context of everyday life used partial measures (Brown & Ryan, 2003). Using partial questionnaires, while less burdensome on diary participants, may not allow for the measurement of the full multi-faceted construct of mindfulness. To date, no study of mindfulness has evaluated state levels of mindfulness using a full questionnaire, nor has the relationship between state mindfulness and daily health behaviors been assessed.

The present study seeks to evaluate the connection between daily measures of mindfulness and daily health behaviors to determine if variations in mindfulness are associated with variations in health behaviors. Further, the study seeks to determine the role of mindfulness in the impact of reactivity to negative events on daily health behaviors. Specifically, the present study seeks to evaluate reactivity in terms of increases in perceived stress and negative affect.

### **Dispositional and State Mindfulness**

While much of the research on mindfulness has focused on it as a therapeutic practice, less research has focused on individual differences in untrained mindfulness. The inherent human capacity for attention and awareness that exists to greater or lesser degrees in all individuals is the basis of mindfulness (Brown & Ryan, 2003; Kabat-Zinn, 2003). Studying mindfulness as an ability inherent in all individuals allows for answering questions related to how individuals differ in their capacities to be mindful, as well as how degrees of mindfulness can vary from situation-to-situation and day-to-day within an individual. It is important to understand how these variations differentially impact health, well-being, and treatment outcomes.

Brown and Ryan (2003) provided evidence that inter-individual differences in mindfulness (i.e., dispositional or trait mindfulness) are associated with well-being. Mindfulness was found to be negatively correlated with measures of depression, anxiety, and negative affect, and positively correlated with positive affect, life satisfaction, self-esteem, and autonomy. Further, these associations held even after

controlling for other constructs commonly associated with well-being, including dispositional self-awareness, rumination, neuroticism, and extraversion.

Dispositional mindfulness was also found to moderate the effects of Mindfulness-Based Stress Reduction in a sample of undergraduate students. Participants who reported higher levels of trait mindfulness experienced a larger increase in mindfulness and well-being throughout the intervention, while those with lower levels of trait mindfulness received less benefit. This is an important finding as the results contribute to understanding treatment effectiveness and individual factors that influence treatment outcomes (Shapiro, Brown, Thoresen, & Plante, 2011).

Mindfulness has been demonstrated as a trait that varies meaningfully between individuals, but less research has focused on mindfulness as a quality that varies within individuals from moment to moment. Within-person variation has been found in other constructs that conceptualized as stable traits, including the Big Five personality factors (Sheldon, Ryan, Rawsthorne, & Ilardi, 1997) and attachment styles (LaGuardia, Ryan, Couchman, & Deci, 2000). Other factors previously associated with mindfulness, including affect, have been found to vary over time (e.g., Watson, 1988). As mindfulness is related to one's experiences as they occur, assessing individuals on how mindful they are in general does not allow for important variation that may occur, and how this variation is associated with other time-varying outcomes. State mindfulness has been shown to be associated with more positive affect and less

negative affect measured at the same point in time, and these effects were independent of an individual's level of dispositional mindfulness (Brown & Ryan, 2003).

### **Measuring Mindfulness/Self Report**

Without sound measures for assessing a construct, researchers would not be able to address questions such as how and under what conditions does mindfulness relate to positive outcomes. Currently self report stands as the most often used method of evaluating levels and changes in mindfulness, whether those changes are day-to-day or occur over the course of intervention. It is important to note that when measuring mindfulness, the wording of measures should not be specific to any type of meditation, and should allow for assessing mindfulness that has been acquired through life experiences as well as formal practice and therapies (A. M. Hayes & Feldman, 2004). Wording of mindfulness measures in this manner allows for the measurement of dispositional and state mindfulness both within and without treatment or practice.

Recent developments in the measurement of mindfulness have helped to validate a multi-faceted construct. Baer, Smith, Hopkins, Krietemeyer, and Toney (2006) developed a self report measure of mindfulness consisting of five facets: observing (attending to internal or external experiences), describing (labeling internal experiences), acting with awareness (attending to one's activities of the moment), nonjudging of inner experience (taking a non-evaluative stance towards thoughts and feelings), and nonreactivity to inner experience (allowing thoughts and feelings to come and go). These facets were derived empirically through exploratory factor

analysis of five existing mindfulness measures: the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003), the Freiburg Mindfulness Inventory (FMI; Buchheld, Grossman, & Walach, 2001), the Kentucky Inventory of Mindfulness Skills (KIMS; Baer, Smith, & Allen, 2004), the Cognitive and Affective Mindfulness Scale (CAMS; Feldman, A. M. Hayes, Kumar, & Greeson, 2004), and the Mindfulness Questionnaire (MQ; Chadwick, Hember, Mead, Lilley, & Dagnan, 2005). The construct validity and differential item functioning of the Five Facet Mindfulness Questionnaire (FFMQ) has been tested and supported using both meditating and nonmeditating samples (Baer et al., 2008; Baer, Samuel, & Lykins, 2011). Validity within nonmeditating samples is of particular interest to this study, as the FFMQ can be used to assess trait mindfulness (levels of untrained mindfulness) and state mindfulness (day-to-day variations) in a nonmeditating sample, of which the current study consists.

### **Mindfulness and Affect**

Much of the research on the construct of mindfulness has focused on its link with emotion. Specifically, mindfulness has been linked to higher positive affect and lower negative affect, as well as lower levels of constructs associated with emotion dysregulation, mainly depressive symptoms, anxiety, and stress, as well as increases in adaptive approaches to problems and emotion regulation (e.g. Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Brown & Ryan, 2003; Coffey & Hartman, 2008;

Feldman, A. M. Hayes, Kumar, Greeson, & Laurenceau, 2007; Jimenez, Niles, & Park, 2010; McKee, Zvolensky, Solomon, Bernstein, & Leen-Feldner, 2007).

The association between mindfulness and affect has been linked to the role of mindfulness in processing emotional experiences. Much of the time, emotion-eliciting events, both internal and external, are processed and reacted to almost instantly. This more reflexive response can be sub-optimal or even detrimental. Mindfulness is an aspect of consciousness that allows a person to more accurately assess the event, which in turn prompts a more appropriate reaction. Brown and Cordon (2009) link mindfulness to emotional well-being in three important ways. First, mindful assessment of stimuli effectively avoids habitual processing, and the response can be deliberate rather than automatic. Second, a clear conception of events allows an unbiased response, that is, an event can be seen for what it is, instead of taken as a sign or a confirmation of a previously held belief or worry. Third, mindfulness can also help an individual keep their emotional response to stimuli in scale and on-track with the event, as opposed to feeling overwhelmed or developing maladaptive responses like rumination and avoidance (e.g. Gross, 1998, 2002; Teasdale, 1999).

There is evidence in the literature on the neural bases of emotion regulation indicating that a relationship exists between mindfulness and changes in biological processes. Specifically, changes in brain activity have been shown in regions associated with emotion regulation in response to mindfulness meditation. Specifically, significant increases in left-side anterior activation were found following

meditation when compared to a control group of non-meditators. Left-side anterior activation is associated with more adaptive response to negative and stressful events, and is also associated with reductions in anxiety and negative affect as well as increases in positive affect (Davidson et al., 2003). Additionally, links have been found between dispositional mindfulness and neural regions underlying reappraisal, an important element in the cognitive control of negative emotion. A study by Modinos, Ormel, and Aleman (2010) found that an increase in dorsomedial prefrontal cortex activation was associated with increased levels of dispositional mindfulness. This activation was negatively correlated with amygdala activity in response to a negative mood inducing task.

### **Mindfulness and Stress**

Studies have investigated the link between dispositional mindfulness and stress. A series of studies conducted by Weinstein, Brown, and Ryan (2009) found that more dispositionally mindful individuals had lower stress appraisals. A study by Baer, Smith, Hopkins, Krietemeyer, & Toney (2006) was consistent with these findings. Mindfulness may allow individuals to process situations in a more accurate manner, resulting in less intense appraisals of stressful situations. This more appropriate appraisal may be linked to better coping mechanisms such as less avoidance of potential negative emotion evoking situations and better approach to positive situations. Currently, no studies have evaluated the direct link between state mindfulness and state levels of perceived stress.



## **Mindfulness and Health**

While mindfulness has been conceptualized as a form of consciousness that allows an individual to disengage from unhealthy automatic thoughts, mindfulness may also allow an individual to disengage from unhealthy automatic behaviors.

Theoretical support for this notion has been drawn from self-determination theory (SDT), which states that open awareness may be particularly important in aiding an individual in choosing behaviors that are consistent with their needs (Deci & Ryan, 1980; Deci & Ryan 1985; Patrick & Williams, 2012; Ryan & Deci, 2000).

Mindfulness may help an individual recognize their needs, which then facilitates (or even motivates) them acting in a manner congruent with these needs (Brown & Ryan, 2003). When an individual is operating on “automatic pilot,” these signals may often be ignored, which can lead to a behavioral dysregulation and negatively impact an individual’s well-being, much like emotional dysregulation (Schwartz, 1984). In addition to ignoring signals from the body, exaggeration of somatic signals may result in dysregulated behaviors like panic (Clark, 1986).

Mindfulness may facilitate an individual being more in tune with their bodily sensations, which may allow for proper engagement with health behaviors in tune with one’s needs. A cross-sectional study examining dispositional mindfulness, physical activity, and eating behaviors found that increased levels of mindfulness were associated with increased physical activity, as well a increased fruit and vegetable intake. Additionally, an inverse relationship between mindfulness and disordered

eating cognitions was found within a non-clinical college population, even after controlling for demographic variables such as gender (Masuda, Price, & Latzman, 2012; Masuda & Wendell, 2010). Furthermore, being more mindful may allow disengagement with stressful feelings, and this more appropriate response to stress may positively impact behaviors such as diet and sleep (Carlson & Garland, 2005; Gilbert & Waltz, 2010). A study by Roberts and Danoff-Burg (2010) found that individuals who reported greater mindfulness also reported better sleep quality, less binge eating, and more physical activity, and stress was found to partially mediate these associations.

In summary, good health behaviors are important for both physical and mental health. Stress had been identified as a factor that negatively impacts physical and mental health, and mindfulness is one avenue by which stress may be alleviated within individuals. To date, much of the research on untrained mindfulness has focused on an individual's inherent level of mindfulness, under the assumption that it is a stable trait. However, mindfulness may demonstrate meaningful temporal variations that could be associated with other time-varying outcomes such as affect. To date, there have been no studies looking directly at links with state mindfulness and state stress, and in particular the impact of these constructs on health behaviors.

### **Overview of the Present Study and Hypotheses**

The aim of the current study was to examine the role of daily mindfulness in daily negative affect, positive affect, health-related behaviors, and reactivity to

negative events. As mentioned previously, a majority of the existing research on mindfulness and its links to well-being has involved measurement of dispositional mindfulness, or how mindful an individual is in general. Reporting on dispositional mindfulness involves retrospective reports at a single point in time, by asking individuals to think back over time and generalize across their usual every day experiences. There are several limitations with this type of assessment approach; most notably that variation in mindfulness from day-to-day cannot be captured. Additionally, a person's impression of how mindful they are in general may not reflect their more momentary reports of mindfulness. Further, it is important to note that self report measures may result in biased or inaccurate reporting by the individual. For example, participants may alter their responses in order to show themselves in the best possible light, to choose extreme values on rating scales, or to be inconsistent across items.

The first study hypothesis was that mindfulness would demonstrate both between-person and within-person variability. Second, it was hypothesized that daily variations in mindfulness would be linked to daily indicators of health behaviors and emotional well-being. Specifically, it was predicted that increased mindfulness on a given day would be associated with increased positive health behaviors (e.g., physical activity, eating attitudes, and quality of sleep), increased positive affect, and decreased negative affect and perceived stress that same day. Third, it was hypothesized that mindfulness would buffer the impact of negative events on individual's daily

perceived stress and negative affect. Specifically, it was predicted that on days when individuals reported being more mindful, they would be less reactive to higher numbers of negative events in terms of perceived stress and negative affect. Fourth, it was hypothesized that mindfulness would buffer the impact of daily perceived stress on health behaviors. It was predicted that on days when individuals reported greater levels of mindfulness, the link between daily perceived stress and health behaviors would be lower.

The hypotheses were tested using a daily diary design with undergraduate college students, mostly first year students. Participants completed online daily surveys for seven consecutive nights. Each night, participants reported momentary emotional well-being (e.g., NA and PA) and their mindfulness during the day using the Five-Factor Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), which measures the facets of observing, describing, acting with awareness, nonreactivity to inner experience, and nonjudging of inner experience. Participants also reported on the number of positive and negative events for the day, levels of perceived stress, physical activity, eating habits, and quality of sleep for the evening prior. The use of the diary methodology allows for participants to report on thoughts and behaviors closer to when they are actually occurring, reducing retrospective reporting biases. Additionally, using a diary methodology allows for a test of the assumption that mindfulness should be considered solely a stable trait. With participants reporting on daily mindfulness across multiple days, it is possible to assess

the degree to which their reports of mindfulness vary from day-to-day and whether within-person variability in mindfulness is reliably related to daily health behaviors and well-being.

## **Chapter 2**

### **METHOD**

#### **Participants**

College student participants were recruited from an introductory psychology course and invited to participate in a “diary study of college students’ mindfulness and health behaviors”. Students received extra credit either for participating in the study or for completing a writing assignment of approximately the same time commitment. Two hundred thirty-three students consented to participate. Of these 233 students, 214 (92%) completed at least four of the seven diary days, a criterion for study inclusion. Four days was chosen as the minimum criterion in order to maximize the potential for day-to-day variation within individuals, and a lower number of required diary days had minimal impact on the number of study completers. Participants were mostly female (66.8%), 18 or 19 years old (57.0% and 26.6%, respectively; range: 18-25 or older) and first-semester first-year college students (67.3%). The racial background of participants was 79.4% Caucasian, 7.4% more than one race, 2.9% African American, 1.5% other, and 8.8% unknown. The ethnic background of participants was 95.8% non-Hispanic/Latino, 3.7% Hispanic/Latino, and 0.5% not reporting.

### **Procedure**

Interested students attended a group information session in the beginning of November at which they provided informed consent and received instruction on how to complete the study measures. Following this meeting, participants completed the initial online survey. The daily diaries began the day after the initial survey and were to be completed between 5 p.m. and 8 p.m. each evening for seven consecutive days. This time frame was chosen to maximize the potential for students to be available to complete the diaries within the same time range each day, at the end of the day. On average, these daily surveys took approximately 10 minutes to complete. Each day, participants received a reminder email containing a link to the daily online survey. Participants were reminded to continue their participation even if they missed a diary that day. Participants were debriefed at the end of the study via email. Two hundred thirty-three participants provided informed consent for the study. Of these, 214 completed at least 4 diaries and were included in the subsequent analyses. Of the 214, 80.6% of participants completed either 6 or 7 diaries (26.4% and 54.2%, respectively).

### **Self Report Measures**

#### **Daily Measures**

Participants completed identical online surveys each night for seven consecutive nights. Participants reported on their daily mindfulness, current affect, stress, and health behaviors using the following measures:

### **Daily Mindfulness**

Daily mindfulness was measured using the Five Factor Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), a 39-item measure assessing five facets related to mindfulness. For purposes of the current study, the wording of the original FFMQ items was adjusted in order to allow participants to report on the particular day's mindfulness as opposed to how mindful the participant is in general. Specifically, participants were given the prompt, "Click in the answer that best describes your own opinion of what was generally true for you today." As an example, the question "I am easily distracted" was changed to "I was easily distracted". Participants indicated how true each item was for them on a five-point scale ranging from 1= *never or very rarely true* to 5= *very often or always true*. Responses to all FFMQ items were summarized into a single composite scale.

There are two main contributing factors, one theoretical and one statistical, in the justification for the use of a composite scale as opposed to individual facet scores. The literature involving the construct of mindfulness was used as a theoretical foundation for the study hypotheses and there is little or no work to support specific predictions regarding the individual facets of mindfulness and how they would relate to the outcome measures. The statistical justification for the use of a total mindfulness composite is that the model used to examine the individual facets would test each facet's unique contribution, above and beyond any shared variance across the facets, in explaining variance in the outcome. Because the five mindfulness facets are expected



to demonstrate moderate to strong inter-correlations, there would likely be little unique variance remaining to be explained by specific facets.

Within-person reliability was estimated for the total FFMQ scores using procedures described by Cranford et al. (2006) and Bolger and Laurenceau (2013) for variance component analysis. The data were organized into a three-level data structure in which mindfulness items were nested within days, and days were nested within participants in order to analyze the systematic change in participants' mindfulness scores over the 7 diary days. The  $R_c$  reliability estimate for the FFMQ was 0.71, indicating acceptable reliability.

### **Daily Affect**

Current affect was assessed using the 10-item Positive Affect (PA) scale and the 10-item Negative Affect (NA) scale from the Positive and Negative Affect Schedule—Expanded Form (PANAS-X; Watson & Clark, 1994). Positive affect items included: interested, excited, strong, inspired, attentive, proud, enthusiastic, alert, determined, and active. Negative affect items included: scared, hostile, distressed, irritable, ashamed, jittery, upset, afraid, guilty, and nervous. Participants rated how much they felt each emotion “in the past hour” on a 5-point scale where 1 indicated *very slightly/not at all* and 5 indicated *extremely*.  $R_c$  reliability estimates for PA and NA were .88 and .82, respectively, indicating good reliability.

### **Positive and Negative Events**

Each participant also completed an inventory of positive and negative events adapted from a previous college student diary study by Dasch, Cohen, Sahl, and Guthert (2008). Items included events common for college students to experience. There were thirteen positive and nineteen negative events, for which students indicated (yes/no) whether the event occurred that day. If participants indicated that an event did occur that day, they also ranked how positive or negative the event was on a four-point scale where 1 indicated *neutral* and 4 indicated *very positive* or *very negative*, depending on whether the item was in the positive or negative event list. Events included both interpersonal and intrapersonal events. Interpersonal events included items such as “Friend, family member, or romantic partner did something special for me” and “Friend, family member, or romantic partner was displeased with me.” Intrapersonal events included items such as “Received a low test grade today” and “Spent enjoyable time pursuing a hobby, extracurricular activity, or other recreation.” The  $R_c$  reliability estimates for positive and negative events were 0.76 and 0.88, respectively, indicating reasonably good reliability.

### **Perceived Stress**

In addition to completing a checklist of negative events and their valence, participants filled out the Perceived Stress Scale (PSS; Cohen, Kamarck, and Mermelstein, 1983) each day. The PSS measures the degree to which an individual perceives their life as being unpredictable, uncontrollable, and overloaded. Cohen et

al. (1988) showed correlations with this scale and other health behavior measures. This scale was modified for a daily diary format by changing the original directions from, “The questions in this scale ask you about your feelings and thoughts during the last month” to “The questions in this scale ask you about your feelings and thoughts during today.” Specific wording of items was also adjusted to fit the daily diary format. For example, “During the last month, how often have you been upset because of something that happened unexpectedly” was changed to “During today, how often were you upset because of something that happened unexpectedly.” Participants responded on 5-point scale where 0 indicated *never* and 4 indicated *very often*. The  $R_c$  reliability estimate for the PSS was .70, indicating acceptable reliability.

### **Physical Activity**

The International Physical Activity Questionnaire-Short Version (IPAQ-S) is a measure comprised of four questions designed to assess health related physical activity. It measures time spent in vigorous, moderate, and walking activities, as well as time spent sitting (Ainsworth et al., 2000). The questionnaire was modified for a daily diary format by adjusting the responding time frame for “the last seven days” to “today”. Participants recorded how much time they spent doing vigorous activities, moderate activities, and walking. Vigorous and moderate activities were defined and examples of each were given. Participants also recorded how much time they spend sitting during the day.

An overall physical activity score was calculated by first transforming each activity (vigorous, moderate, and walking) into their respective MET-minutes score, where MET is a Metabolic Equivalent Task. The MET-minute score is computed by multiplying the MET score of an activity by the number of minutes spent doing the activity. The  $R_c$  reliability estimate for the physical activity was .24 indicating poor reliability.

### **Daily Eating Attitudes**

The Eating Attitudes Test (EAT-26, Garner et al., 1982) is a 26-item questionnaire measuring the symptoms and concerns characteristic of eating disorders. This questionnaire is appropriate for use in non-clinical settings, and yields an indicator of eating disorder risk. This measure was selected as a means to monitor variations in an individual's attitudes towards eating. The wording of items was adjusted in order to fit a daily diary format. For example, "Am terrified about being overweight" was changed to "Was terrified about being overweight". Participants indicated *yes* or *no* to each question. Higher scores represent a more disordered eating attitude for the day. The  $R_c$  reliability estimate for the EAT-26 was .77, indicating acceptable reliability.

### **Sleep Quality**

Participants reported on sleep duration and quality for the prior evening on each diary. Items were provided from Hamilton et al.'s (2008) diary study of fibromyalgia and sleep and included questions regarding the number of hours spent

asleep and how refreshed or rested the individual felt following the last night's sleep. A daily sleep quality score was computed for each participant where higher numbers indicated better sleep quality. Lead variables were created for sleep quality in order to match reported sleep quality with the same day's report of other variables. The  $R_c$  reliability estimate for sleep was 0.60, indicating acceptable reliability.

### **Data Analytic Strategy**

The data consisted of seven consecutive daily observations from each of the 214 participants conforming to a multilevel data structure. Accordingly, we used a multilevel modeling data analytic approach. Analyses were carried out in Mplus v6.12 (Muthén & Muthén, 1998-2010). We constructed a model to examine daily mindfulness and stress reactivity as predictors of daily health behaviors. This method accommodates missing data (or unbalanced repeated measures designs) and is particularly useful for analyzing data with a nested structure (i.e., daily assessments within individuals).

All analyses were conducted to emphasize daily within-person associations between mindfulness and other daily variables. All predictors were entered into the model group-mean centered, meaning that they were centered around each participant's data by subtracting the participant's mean from his or her daily value of each variable. The model tested whether daily changes in a person's stress reactivity was moderated by levels of mindfulness, and whether day-to-day variations in mindfulness were related to changes in daily health behaviors and other measures of

well-being.

### **Chapter 3**

#### **RESULTS**

The dataset consisted of 214 participants reporting once daily over four to seven days for a total of 1516 observations. Frequency distributions for each of the variables intended for use in analyses were examined to determine whether normal-shaped distributions were present for each variable. Negative affect (NA) and negative events (NE) demonstrated count-shaped distributions and therefore were modeled as a Poisson distribution.

Means and standard deviations for study variables are presented in Table 1, and within-person correlations of all study variables are presented in Table 2. Intra-class correlations (ICCs) were computed for all outcome and predictor variables, as all study variables were measured daily for all participants. The ICC is a measure of dependency within the data and refers to the degree of similarity between data reported on days from the same individual. Stated differently, it provides a measure on what proportion of the total variance for a variable is due to within- versus between-person variability. The ICC for the mindfulness score was .69, indicating that sixty-nine percent of the variability in mindfulness scores was due to between-person differences, or the degree to which individuals within the sample differed from each other. Thus, twenty-nine percent of the variability was due to within-person variability, or how

much individuals differ from day-to-day on their reports of mindfulness. This supports the first hypothesis that mindfulness would demonstrate both between- and within-person variability. The ICC's for the other daily outcomes and predictors in this study are listed in Table 3.

Table 1

*Means and Standard Deviations for Major Study Variables*

| Variable          | <i>M</i> | <i>SD</i> |
|-------------------|----------|-----------|
| Positive Affect   | 26.26    | 6.73      |
| Negative Affect   | 15.99    | 5.29      |
| Positive Events   | 3.45     | 1.91      |
| Negative Events   | 1.74     | 2.10      |
| Perceived Stress  | 14.75    | 5.42      |
| Mindfulness       | 124.94   | 13.98     |
| Eating Attitudes  | 3.61     | 4.71      |
| Quality of Sleep  | 24.59    | 2.94      |
| Physical Activity | 4.48     | 2.82      |

*Note.* *N* = 214. Aggregated over the 7 days of diary data.

Table 2

*Within-Person Correlations between all Study Variables*

|                     | 1      | 2      | 3      | 4      | 5      | 6     | 7    | 8    | 9 |
|---------------------|--------|--------|--------|--------|--------|-------|------|------|---|
| 1. Positive Affect  |        |        |        |        |        |       |      |      |   |
| 2. Negative Affect  | -.08*  |        |        |        |        |       |      |      |   |
| 3. Negative Events  | -.05*  | .19**  |        |        |        |       |      |      |   |
| 4. Mindfulness      | .23**  | -.27** | -.10** |        |        |       |      |      |   |
| 5. Perceived Stress | -.25** | .40**  | .19**  | -.41** |        |       |      |      |   |
| 6. Positive Events  | .29**  | -.09*  | .34**  | .08*   | -.12** |       |      |      |   |
| 7. Eating Attitudes | .01    | .05    | .16    | -.03   | .04    | .11*  |      |      |   |
| 8. Exercise         | .14**  | -.01   | .00    | .11**  | -.02   | .14** | .08* |      |   |
| 9. Sleep Quality    | .08**  | -.18** | -.07*  | .12**  | -.17** | .03   | -.05 | -.00 |   |

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



Table 3

*Intra-Class Correlations for all Daily Predictor and Outcome Variables*

| Variable                      | ICC |
|-------------------------------|-----|
| Predictors                    |     |
| Total FFMQ                    | .69 |
| Perceived stress <sup>a</sup> | .58 |
| Negative events <sup>a</sup>  | .47 |
| Outcomes                      |     |
| Positive affect               | .45 |
| Negative affect               | .54 |
| Physical activity             | .38 |
| Eating attitudes              | .81 |
| Sleep quality                 | .29 |
| Positive events               | .40 |

*Note.*  $N = 214$ .

<sup>a</sup> Variable was used as an outcome in some analyses.

The data were analyzed using a multilevel model that examined within-subject variations in mindfulness and the impact on daily health behaviors. It was hypothesized that day-to-day variations in mindfulness would impact daily health behaviors (e.g., physical activity, eating attitudes, and sleep) and general indicators of well-being (e.g., levels of positive and negative affect, positive and negative events, and perceived stress). It was hypothesized that higher mindfulness within a specific day would be associated with better health behavior and well-being reports for that day within individuals. Increased levels of mindfulness within a particular day were associated with increased PA ( $b = 0.17, p = .00, 95\% CI = 0.12, 0.23$ ), decreased NA ( $b = -0.13, p = .00, 95\% CI = -0.16, -0.09$ ), more physical activity ( $b = 0.04, p = .01, 95\% CI = 0.01, 0.06$ ), less perceived stress ( $b = -0.20, p = .00, 95\% CI = -0.23, -0.16$ ), more reported positive events ( $b = 0.02, p = .02, 95\% CI = .00, 0.03$ ), and less reported

negative events ( $b = -0.02, p = .00, 95\% CI = -0.03, -0.01$ ). Associations between daily mindfulness and eating attitudes ( $b = -0.01, p = 0.53, 95\% CI = -0.02, 0.01$ ) and sleep ( $b = 0.01, p = 0.60, 95\% CI = -0.02, 0.04$ ) were not statistically significant.

Between-person effects were found such that people who had higher average mindfulness across the seven days also reported decreased average perceived stress scores ( $b = -0.08, p = .01, 95\% CI = -0.14, -0.02$ ) and lower unhealthy eating attitudes scores ( $b = -0.05, p = .02, 95\% CI = -0.09, -0.01$ ). No effects were found for PA ( $b = -0.01, p = .90, 95\% CI = -0.10, 0.09$ ), NA ( $b = -0.00, p = .81, 95\% CI = -0.01, 0.01$ ), positive events ( $b = 0.00, p = .40, 95\% CI = -0.00, 0.01$ ), negative events ( $b = -0.00, p = .47, 95\% CI = -0.01, 0.01$ ), physical activity ( $b = -0.03, p = .10, 95\% CI = -0.06, 0.01$ ), and sleep quality ( $b = 0.04, p = .07, 95\% CI = -0.00, 0.09$ ).

An examination of a within-subject process of reactivity to daily negative events was conducted such that the degree to which number of negative events is related to perceived stress depends on the level of mindfulness that particular day. It was predicted that increased reactivity to negative events would be shown in individuals with lower levels of mindfulness. Increased perceived stress and increased negative affect were used as indicators of reactivity to negative events, and therefore were entered into separate models as outcomes of the interaction between mindfulness and negative events. The results for a statistical test of reactivity to negative events as evidenced by increased perceived stress are presented in Table 4, and the results for reactivity to negative events as evidenced by increased negative affect are presented in

Table 5. The results of perceived stress on the interaction of mindfulness and negative events are seen in the upper portion of Table 4, labeled fixed effects, and in the line mindfulness by NE. Mindfulness did not moderate the relationship between negative events and the impact on perceived stress ( $b = 0.01, p = .26, 95\% CI = -0.01, 0.02$ ). In Table 5, it can also be seen that mindfulness did not moderate the relationship between negative events and negative affect ( $b = -0.01, p = .21, 95\% CI = -0.02, 0.00$ ). It is important to note that the analysis model also included time in days, so effects were not due to temporal changes in the outcome.

Table 4

*Estimates for multilevel model of perceived stress as a function of mindfulness and negative events.*

|   |                 |             |          | 95% <i>CI</i> |       |
|---|-----------------|-------------|----------|---------------|-------|
| Fixed effects (intercept, slope)              | <i>Estimate</i> | <i>(SE)</i> | <i>p</i> | Lower         | Upper |
| Intercept                                     | 23.43           | 3.67        | <.001    | 16.23         | 30.62 |
| Time (per 7 days)                             | 0.45            | 0.06        | <.001    | 0.33          | 0.58  |
| Within Mindfulness                            | -0.19           | 0.02        | <.001    | -0.22         | -0.15 |
| Within Negative Events                        | 0.08            | 0.78        | .92      | -1.46         | 1.62  |
| Within Mindfulness by NE                      | 0.01            | 0.01        | .26      | -0.01         | 0.02  |
| Between Mindfulness                           | -0.08           | 0.03        | .003     | -0.14         | -0.03 |
| Between Negative Events                       | 0.00            | 0.15        | .99      | -0.29         | 0.29  |
|   |                 |             |          | 95% <i>CI</i> |       |
| Random effects ((co-)variances)               | <i>Estimate</i> | <i>(SE)</i> | <i>p</i> | Lower         | Upper |
| Level 2: between person                       |                 |             |          |               |       |
| Intercept                                     | 11.41           | 1.70        | <.001    | 8.07          | 14.75 |
| Within Mindfulness Slope                      | 0.00            | 0.00        | .34      | -0.00         | 0.01  |
| Within Negative Events                        | 0.65            | 0.18        | <.001    | 0.30          | 1.00  |
| Within Mindfulness Slope &<br>Within NE slope | -0.02           | 0.03        | .58      | -0.07         | 0.04  |
| Intercept & Within Mindfulness<br>Slope       | -0.02           | 0.06        | .73      | -0.13         | 0.09  |
| Intercept & Within Negative<br>Event Slope    | 0.35            | 0.49        | .47      | -0.61         | 1.31  |
| Level 1: Within Person                        | 13.85           | 0.92        | <.001    | 12.04         | 15.66 |
| Residual                                      |                 |             |          |               |       |

*Note.* CI = confidence interval. NE = Negative events.

Table 5

*Estimates for multilevel model of perceived stress as a function of mindfulness and negative affect.*

|  |                 |             |          | 95% <i>CI</i> |       |
|--|-----------------|-------------|----------|---------------|-------|
| Fixed effects (intercept, slope)           | <i>Estimate</i> | <i>(SE)</i> | <i>p</i> | Lower         | Upper |
| Intercept                                  | 14.02           | 5.88        | .02      | 2.49          | 25.55 |
| Time (per 7 days)                          | 0.19            | 0.08        | .02      | 0.04          | 0.34  |
| Within Mindfulness                         | -0.11           | 0.02        | <.001    | -0.16         | -0.07 |
| Within Negative Events                     | 1.56            | 0.92        | .92      | -0.25         | 3.37  |
| Within Mindfulness by NE                   | -0.01           | 0.01        | .21      | -0.02         | 0.00  |
| Between Mindfulness                        | 0.02            | 0.04        | .58      | -0.06         | 0.11  |
| Between Negative Events                    | 0.94            | 2.72        | .73      | -4.39         | 6.27  |
|  |                 |             |          | 95% <i>CI</i> |       |
| Random effects ((co-)variances)            | <i>Estimate</i> | <i>(SE)</i> | <i>p</i> | Lower         | Upper |
| Level 2: between person                    |                 |             |          |               |       |
| Intercept                                  | 14.69           | 2.46        | <.001    | 9.86          | 19.52 |
| Within Mindfulness Slope                   | 0.01            | 0.01        | .39      | -0.01         | 0.02  |
| Within Negative Events                     | 0.19            | 0.28        | .49      | -0.35         | 0.73  |
| Within Mindfulness Slope & Within NE slope | -0.02           | 0.04        | .53      | -0.09         | 0.05  |
| Intercept & Within Mindfulness Slope       | -0.33           | 0.09        | <.001    | -0.50         | -0.16 |
| Intercept & Within Negative Events Slope   | 1.05            | 0.59        | .07      | -0.10         | 2.20  |
| Level 1: Within Person                     | 18.13           | 2.39        | <.001    | 13.45         | 22.82 |
| Residual                                   |                 |             |          |               |       |

*Note.* CI = confidence interval. NE = Negative events.

Finally, it was hypothesized that there would be an interaction between mindfulness and perceived stress in predicting health behaviors. It was predicted that on days when an individual was more mindful, the negative impact of perceived stress on health behaviors would be less severe. Individuals low on mindfulness would show a stronger negative relationship between perceived stress and health behaviors. There was no significant interaction between and mindfulness and perceived stress when

predicting physical activity. There was a significant interaction for both eating attitudes ( $b = 0.001$ ,  $p = .00$ , 95%  $CI = 0.000, 0.002$ ) and sleep ( $b = -0.002$ ,  $p = .00$ , 95%  $CI = -0.002, -0.001$ ). For eating attitudes, on a day in which an individual reported less perceived stress, greater mindfulness was associated with worse eating attitudes. On days in which an individual reported increased perceived stress, mindfulness did not appear to help. For quality of sleep, sleep quality was highest when an individual reported both increased perceived stress and increased daily mindfulness. Sleep quality was lowest when people reported both low perceived stress and low daily mindfulness. Quality of sleep for the previous night was controlled for in this analysis.

## **Chapter 4**

### **DISCUSSION**

The current study used a daily diary design to examine the role of daily mindfulness in daily negative affect, positive affect, health-related behaviors, and reactivity to negative events. It was hypothesized that mindfulness would demonstrate both between-person as well as within-person variability. It was also hypothesized that daily variations in mindfulness would impact daily health behaviors. It was predicted that increased mindfulness would be associated with increased positive health behaviors within the same day. It was hypothesized that mindfulness would buffer the impact of negative events on individual's daily perceived stress and negative affect. Specifically, it was predicted that on days when individuals reported being more mindful, they would be less reactive to stress, as measured by negative events, and therefore report lower levels of perceived stress and negative affect. Finally, It was hypothesized that mindfulness would buffer the effects of stress on daily health and well-being.

The hypothesis that mindfulness would demonstrate both between- and within-person variability was supported. This finding is important, as it replicates and supports the one published study we are aware of showing that mindfulness has meaningful state variations (Brown & Ryan, 2003). Providing further evidence that

mindfulness reliably varies from day-to-day allows for the investigation of hypotheses regarding how those variations may be linked to aspects of daily physical and emotional health, which is important for identifying the benefits of mindfulness as well as understanding how those benefits manifest themselves on a day-to-day basis.

Support was found for the hypothesis that state mindfulness would predict increases in daily health and emotional well-being outcomes. This both supports previous research on the benefits of dispositional mindfulness on similar outcomes, as well as extends findings to include measures of the impact on daily health outcomes. Specifically, there was a significant effect for mindfulness predicting increases in physical exercise and indicators of emotional well-being, but not a significant effect for mindfulness predicting increases in better eating attitudes and quality of sleep. This may indicate that mindfulness impacts health behaviors in different ways.

Mindfulness did not moderate the relationship of negative events on perceived stress or negative affect. Perceived stress and negative affect were used as indicators of reactivity to negative events. It was predicted that increased state mindfulness would decrease the impact of negative events on perceived stress and negative affect. A possible explanation for why this hypothesis was not supported may be the assumption that individuals who endorsed more daily negative events would actually consider these events to have significantly impacted their daily life. It is possible that a negative event endorsed on the list occurred but was not perceived to be sufficiently negative or impactful by the individual. If an individual does not perceive an event to be



significantly negative, there may be little chance that this will impact their perceived stress levels or negative affect. An assessment of the valence of the negative event may be better suited for associating with perceived stress.

Interesting interactions were observed such that mindfulness moderated the relationship between perceived stress and eating attitudes and sleep quality. In terms of eating attitudes, overall higher stress was related to better eating. On days when an individual reported less perceived stress, increases in mindfulness had a stronger relationship with healthy eating attitudes. When an individual was more stressed, the results suggest that mindfulness was not linked with eating attitudes. A possible explanation for this is that while increases in stress have been linked with increases in unhealthy eating behaviors (Kiecolt-Glaser, 2010), cognitions about eating may not be affected in the same way that behaviors are.

The interaction of mindfulness and perceived stress in relation to sleep quality showed that individuals reported the best sleep quality when they were both more stressed and more mindful. Sleep quality was worst when individuals were lower on perceived stress and mindfulness. A possible explanation for this is that on days when an individual is more mindful, they are able to more accurately interpret stress. So, on a day when an individual is more mindful and reporting higher levels of perceived stress, these higher levels of perceived stress may be indicative of real stress within the individual's day. This potentially more accurate assessment of increased stress may be taxing on an individual, resulting in a need for more sleep. Because an individual is

also reporting higher mindfulness, they may be accurately assessing stress within their day without becoming overly engaged with that assessment, allowing them to experience better sleep quality that evening when they really need it.

### **Strength, Potential Limitations, and Clinical Implications**

An important strength of this study was the examination of state mindfulness using the Five-Factor Mindfulness Questionnaire. Prior research on state mindfulness has involved the use of a brief version of the Mindful Attention Awareness Scale (MAAS, Brown & Ryan, 2003). The MAAS measures the attention and awareness aspect of the construct of mindfulness, but does not assess the non-reactive or non-judgmental aspects of the construct. The FFMQ may serve as a broader and more inclusive measure of the construct of mindfulness. Additionally, the full FFMQ was used as opposed to a brief version, to better measure the full construct of mindfulness and its day-to-day variations. This study replicates Brown and Ryan's (2003) finding that mindfulness was associated with increased positive affect and decreases negative affect. However, it also builds on these findings by showing associations with daily physical activity, perceived stress, negative events and positive events, all of which can factor into indicators of well-being. Additionally, the use of a daily diary design allows for the study of state mindfulness and the isolation of within-person associations between it and the outcomes.

There are several important limitations of the study that are important to note. First, while state mindfulness was assessed on a daily level, assessing state

mindfulness within the context of a specific event may provide a better picture for the relationship between mindfulness and the outcome variables assessed in this study. An ecological momentary assessment may provide the means by which to look at mindfulness within a specific situation. However, it also important to note that assessing mindfulness multiple times throughout a day may be too cumbersome using the entire 39 item FFMQ. A potential area for future research may look into the development of a shortened version of the FFMQ for use in intensive longitudinal designs that still accurately captures important facets of the construct.

Additionally, there were some limits to the measurement of health behaviors. The Eating Attitudes Test-26 (EAT-26) was used to measure disordered eating thoughts as an indicator of poor diet habits. However, these disordered thoughts may not have accurately mapped on to the eating behaviors that participants actually exhibited during the day. Having participants keep a food diary in addition to the other measures reported in this study might give rise to better assessment of eating behaviors on a daily level. However, it is important to keep in mind the demands of a daily diary questionnaire, and balance that with assessing enough information without being too burdensome on participants.

The measurement of sleep was somewhat limited. Participants completed the questionnaires each night between 5 p.m. and 8 p.m. Because of this, participants were reporting on sleep for the *prior* evening. This opens up the possibility for inaccurate reporting on the sleep quality of that evening. A potential future direction for this type

of study may include assessing sleep in the morning, immediately after an individuals wakes, to get a more accurate picture of their sleep quality, and in turn a more accurate look at how state (daily) mindfulness impacts the same day's sleep habits.

The study outcomes (e.g., affect) were only measured at one time point during the day. Having another measure of affect during the day may help assess whether increased affect at one time point results in increased mindfulness at a different time point within the same day, and vice versa. Having affect measured at multiple time points would allow for a more thorough examination of the directionality of effects.

This study provides some meaningful clinical implications. Previous research has investigated the role of dispositional mindfulness at the start of MBSR treatment and found that dispositional mindfulness served as a moderating factor on the effects of treatment such that individuals with greater pretreatment dispositional mindfulness showed a larger increased in mindfulness and well-being at the end of the study. This is an important finding as it provides an indicator for whom this treatment may be most beneficial (Shapiro, Brown, Thoresen, & Plante, 2010). It was possible that the results could have shown that were ceiling effects for how mindful a person could become. Assessing daily mindfulness across an intervention aimed at increasing mindfulness may aid in both the monitoring of progress as well as assist in generalizing formal practice to day-to-day events. Providing clients with feedback as to how their daily levels of mindfulness impact their daily health and well-being may serve as a motivating factor.

### **Concluding Comments**

In conclusion, a daily diary design was used to evaluate the associations between daily mindfulness, daily health behaviors, daily indicators of emotional well-being, daily events, and perceived stress. This study represents one of the few in the literature to have assessed mindfulness and links to theoretically hypothesized outcomes within the context of everyday life. As expected, mindfulness demonstrated both within- and between person associations. In addition, state mindfulness predicted increases in health behaviors and emotional well-being. The hypotheses for state mindfulness moderating the effect of negative events on perceived stress and negative affect were not supported. This study adds to a growing literature suggesting that the relationships between state mindfulness and state indicators of health and well-being are meaningful. A methodological strength of the study was the assessment of mindfulness on a daily basis using the full FFMQ, as opposed to using more abbreviated state measures or trait-like cross-sectional questionnaires.

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**Appendix**  
**IRB APPROVAL LETTER**



## RESEARCH OFFICE

210 Hulihan Hall  
University of Delaware  
Newark, Delaware 19716-1551  
Ph: 302/831-2136  
Fax: 302/831-2828

DATE: October 25, 2011

TO: Lawrence Cohen, PhD  
FROM: University of Delaware IRB

STUDY TITLE: [279559-1] Daily Diary Study of College Students' Mindfulness and Health Behaviors

SUBMISSION TYPE: New Project

ACTION: APPROVED  
APPROVAL DATE: October 25, 2011  
EXPIRATION DATE: October 24, 2012  
REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # 7

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Jody-Lynn Berg at (302) 831-1119 or [jlberg@udel.edu](mailto:jlberg@udel.edu). Please include your study title and reference number in all correspondence with this office.