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JUST BREATHE: MINDFULNESS, SELF-REGULATION, AND CARDIAC REACTIVITY

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JUST BREATHE: MINDFULNESS, SELF-REGULATION, AND CARDIAC REACTIVITY

by

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Just Breathe: Mindfulness, Self-Regulation, and Cardiac Reactivity

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Declaration of Originality

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Abstract

Dispositional mindfulness is the non-judgmental moment-to-moment awareness of transient thoughts, feelings, and sensations as they arise in the attentional field (Kabat-Zinn, 1990). This phenomenon has been a primary element of various clinical interventions for many years. However, little is known about the active ingredients of mindfulness that promote emotional self-regulation and coping. The aim of this dissertation was to address this gap through three related studies which utilized an undergraduate sample. The first study used a laboratory protocol that required participants to perform several mildly stressful tasks related to emotional recall, mindful breathing, and a recovery condition. The hypothesis that high self-ratings of mindfulness correspond to more adaptive sympathetic and parasympathetic self-regulation relative to these tasks was tested. The second study examined the associations among self-rated emotional regulation strategies, ruminative tendencies, and mindfulness skills to test the hypothesis that mindfulness is negatively related to rumination and emotional dysregulation. Finally, the third study tested the hypothesis that mindfulness skills are associated with more benign perceptions of environmental stress, as well as a more adaptive estimation of the resources available to cope with stress, such as perceived social support and academic self-efficacy. Results suggested that self-rated mindfulness was associated with adaptive emotional self-regulation across task conditions. Results of this triad of studies suggest that mindfulness is associated with a lower likelihood of maintaining a prolonged fight or flight response after the stressor has been removed, and that specific mindful skills may work synergistically to promote effective coping and resilience. Implications for the development of future mindfulness interventions are discussed.

Keywords: mindfulness, self-regulation, coping

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Glossary of Terms

Terms and Their Acronyms - Psychophysiology	
Anterior Cingulate Cortex	ACC
Autonomic Nervous System	ANS
Autoregressive Analysis	AR
Cardiovascular Control Centre	CCC
Central Nervous System	CNS
Coarse-Grain Spectral Analysis	CGSA
Diastolic Blood Pressure	DBP
Fast-Fourier Transformation	FFT
Heart Rate Variability	HRV
High Frequency Heart Rate Variability	HF-HRV
Low Frequency Heart Rate Variability	LF-HRV
Mean Arterial Pressure	MAP
N-N Interval	The interval between two heartbeats
Parasympathetic Nervous System	PNS
R-R Interval	The interval between two heartbeats
Systolic Blood Pressure	SBP
Skin Conductance Reactivity	SCR
Sympathetic Nervous System	SNS
Very Low Frequency Heart Rate Variability	VLF-HRV

Terms and Their Acronyms – Questionnaires	
Calming Phase	CP
Five Factor Mindfulness Questionnaire	FFMQ
Mindful Attention Awareness Scale	MAAS
Mindful Breathing Exercise	MBE
Social Competence Interview	SCI
Toronto Alexithymia Scale	TAS-20
Toronto Mindfulness Scale	TMS

CHAPTER 1

Literature Review

Mindfulness has been called the “heart” of Buddhist meditation (Kabat-Zinn, 2003; Thera, 1962). It has also been described as a process whereby attention is brought to moment-by-moment emotional, bodily, and cognitive experiences (Kabat-Zinn, 1990). This quality is often supported by focusing on breathing, and by intentionally bringing one’s attention back to the breath each time it wanders. Thich Nhat Hahn (1976) describes breath as “the bridge which connects life to consciousness, which unites your body to your thoughts” (p.78). Maintaining focus on the breath is an active, intentional self-regulatory process. Kabat-Zinn (2005) describes it as the ‘scaffolding’ used to develop the state of mindfulness, whereby the experience of the present moment, with attendant thoughts, emotions, and sensations, is enriched. Mindfulness can be supported and internalized by the practice of meditation (Brown & Ryan, 2003; Kabat-Zinn, 2005).

The last few decades have seen mindfulness training included as the primary element in various clinical interventions, such as Mindfulness-based Stress Reduction (MBSR; Kabat-Zinn, 1982). Mindfulness-Based therapeutic approaches are designed to teach individuals how to focus on the present. Research into MBSR and other mindfulness-based therapies has documented benefits for emotional health, particularly in the improvement of the self-regulation of emotions among individuals suffering from anxiety (Borkovec, 2002; Davidson et al., 2004) and promotion of resiliency and prevention of relapse among individuals suffering from depression (Teasdale et al., 2002).

Objectives of the Review

It is the purpose of this chapter to describe the intersection of mindfulness with modern psychological science. This chapter begins by reviewing the cultural roots of the history of mindfulness. Theoretical models and their relation to formal measures of mindfulness are described, with the aim of understanding the nature of mindfulness as a modern scientific construct. Then, the nature and effectiveness of clinical interventions are explored with emphasis on the active ingredients of mindfulness. The key biological, behavioural, and emotional processes that underlie these active ingredients are described and operationalized with reference to research methods with a focus on how they might be scientifically operationalized.

Following the review, three studies are outlined. The first study, proposed in Chapter Two, focuses on the experimental induction of mindfulness and investigates the change as measured by formal self-report mindfulness measures and validated by external (biological) referent measures of skin response, blood pressure and heart rate. The second study, proposed in Chapter Three, investigates the relations between mindfulness and emotional dysregulation. The third study, proposed in Chapter 4, examines the associations between self-reported mindfulness, appraisal of threat and coping.

History of the Mindfulness Tradition

Mindfulness practice can be traced back to the ancient religions of India, and can be described by the Sanskrit word *dharma*. Dharma can be defined as “truth” or simply “the way things are”, and focuses on attaining the ultimate truth or reality of human experience. Dharma stresses that to attain wisdom one must understand the nature of things, though with the awareness that one's mind is a fallible observer prone to transient mental states (Bodhi, 1994). Though the subject of many definitions, mindfulness may be broadly understood as a compassionate, non-judgmental state of paying attention to the immediate experience, without excessively dwelling on or attaching meaning to any transient experience (Bishop, 2004). The goal is to observe experience, whether within the person or occurring in the external environment, without describing it or making judgements about it.

Mindfulness is not strictly a Buddhist concept, but it is founded in Buddhist teachings and writings. The main contribution of Buddhist thought is the meditation techniques that have developed mindfulness at the core (Bodhi, 1994; Thera, 1962; Grossman & Van Dam, 2011). According to Buddhist views, only insight (vipassana) can truly generate the wisdom to achieve enlightenment and learn to perceive the true nature of reality. Progress cannot be made without first developing mental focus through *Samatha* (Bodhi, 1994). *Samatha*, or *Shamatha*, a Sanskrit word meaning "peacefully abiding" is the calm reflective state that fosters refined attention and awareness, and has four foundations: mindfulness of body, of feelings or sensations, of mental states, and of mental objects or qualities (Bodhi, 1994). The breath often serves as a practical point of focus, and bringing consciousness back to the breath helps one remain attentive to the present moment. Active practice is thought to be central to *Samatha*, because mindfulness is not a static trait, but a dynamic process with synergistic components. Buddhist texts refer to mindfulness as a multifaceted practice, which can be cultivated to enhance all aspects of one's daily life.

Mindfulness has been co-opted by secular practitioners who define it as a universal human quality (Baer, 2011; Dimidjian & Linehan, 2003; Kabat-Zinn, 2003). As noted by Kabat-Zinn (2003), "we are all mindful, to one degree or another" (p. 145). According to some meditation experts, mindfulness exists in all people as a natural, untrained characteristic that varies within the population and which can be cultivated and applied in daily life (Davidson, 2010; Rapgay & Bystrisky, 2009). Through their study of Buddhist teachings and practices, early scientists and mindfulness practitioners gained a better understanding of what mindfulness is and how it could be developed through practice. However, as Jon Kabat-Zinn (2003) observed, their objective was not to teach Buddhism, but to develop effective methods for reducing mental and physical discomfort, which made it necessary to treat it independent of the religious and cultural context in which it evolved. In the process of operationalizing mindfulness for use in secular research and practice, Western scientists have co-opted the construct of mindfulness, treating it as independent from the original religious and cultural context within which it evolved. It is the purpose of the next section to explain how the construct of mindfulness fits within existing theories of stress and emotional regulation.

Mindfulness and Theories of Stress and Emotional Regulation

The promising findings that mindfulness practice improves the regulation of negative emotions and the alleviation of stress has spurred on increasing interest in mindfulness among secular researchers (Borkovec, 2002). As the competitiveness of modern life grows due to fast-paced changes in technology and as well as other factors, individuals are faced with an increasing number of stressors. The constant barrage of information via email or phone, leaves little opportunity to relax and regroup, making it difficult to cope for many individuals. In this climate, a set of practical skills believed to improve the ability to adaptively respond to stress by reducing negative affect is very desirable.

A number of researchers have now proposed models of how mindfulness skills promote stress reduction. These models emphasize the neural correlates (Holzel et al., 2011) and attentional processes (Shapiro, Carlson, Astin, & Freedman, 2006) that support mindful experience. An understanding of where mindfulness fits into emotional regulation and stress generation processes is emerging.

The current understanding of how an organism functions under stress owes much to the work of Lazarus and Folkman (1984). According to the *cognitive-transactional stress theory,* stress refers to a particular relation between person and environment, when demands tax or exceed the person's resources. Stress is the result of a subjective appraisal process determined by a combination of factors within the person (such as specific motives, beliefs and temperamental characteristics) and within the environment (which may pose harm, threats, or challenges depending on the characteristics of the person; Lazarus & Folkman, 1984). Initially, the individual evaluates the significance of the stressor or threatening event – a process referred to as *primary appraisal*. During primary appraisal, the person decides whether the stressor is harmful, irrelevant or beneficial to the person's goals, commitments, and values (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). Once the stressor is assessed to have personal relevance for the individual and his or her goals, the person takes account of whether adequate resources are available to derive benefit or at least to prevent harm caused by the situation during *secondary appraisal*. The person weighs options on how and whether to act, which may include changing the situation or holding off on acting until more information is available (Folkman et al., 1986). Resources to handle the situation may include level of ability or availability of social support. Primary and secondary appraisals converge to determine whether the person-environment transaction puts important goals in danger by threatening harm or loss, or whether it is primarily challenging, or holds the possibility of mastery or benefit (Folkman et al., 1986). If demands tax or exceed the person's resources and the transaction is judged as threatening, negative emotions may result. If this occurs repeatedly, stress may have harmful effects on physical health (McEwen & Stellar, 1993).

Mindfulness is relevant to the person-environment transactional process that generates stress because individuals with well-developed mindfulness skills appear to be less likely to experience daily events as threatening (Palmer & Rodger, 2009; Weinstein, Brown, & Ryan, 2009). When presented with visual stimuli with potentially negative content, individuals with high self-ratings on measures of mindfulness show greater activation of cortical brain regions associated with the reappraisal of emotionally relevant environmental stimuli (Modinos, Ormel, & Aleman, 2010). It has been suggested that mindfulness enhances individuals' ability to evaluate feedback from the environment in a way that is more balanced than one characterized by rigid negative cognitive schemas (Teasdale, 2002). It appears that mindful individuals do something unique when they appraise information about events, which has positive results for affect and long-term health. This is important because the experience of stress and the ability to cope is dependent on emotional regulation.

Recent models have extended the concept of emotional regulation to differentiate processes that lead to appraisal and follow from it, with emphasis on how emotional regulation unfolds dynamically as the person incorporates feedback from the environment and responds cognitively and emotionally. It is the purpose of the next section to explain how emotional regulation affects the experience of stress, with emphasis on mindfulness skills.

Emotional Regulation, Mindfulness, and Coping

Emotional regulation is usually defined as a way of managing or controlling emotion in the interest of accomplishing desired goals within a specific context or situation (Cole, Michel, & Teti, 1994; Thompson, 1994). Emotional regulation was conceptualized as a method to control emotional for instrumental purposes: a way to change or subdue them in order to bring about a certain outcome. Examples include successful performance on tasks that require delay or inhibition, such as delaying fun activities to study and achieve a good grade on a test (Thompson, 1994). These models emphasized emotional management rather than awareness. Later theorists extended the idea of emotional regulation to suggest that the ability to attend to one's emotions and to be able to differentiate among them is just as important as the ability to manage emotions (Gross, 2002; Paivio & Greenberg, 1998). The transactions between the person and the environment that may result in emotion are dynamic, in that they are continually subject to change due to new environmental feedback (Lazarus, 1990). How individuals notice, appraise, and interpret this feedback determines the emotional, or affective, response (Lazarus, 1990). While some emotional reactions are automatic, such as recoiling from a snake, others arise only after considerable analysis of meaning, such as growing angry after feeling patronized by someone (Gross, 2002).

In his 2002 paper, Gross developed a process model of emotional regulation, where regulation strategies are conceptualized as stages, unfolding as the individual's emotive response to a stressful or challenging situation develops. He drew a distinction between *antecedent*- and *response- focused strategies*. Antecedent-focused strategies occur before an emotional response is fully generated, while response-focused strategies, which have to do with response modulation, occur after an emotional response is fully generated (Gross, 1998). When using antecedent-focused strategies, people employ certain behaviours to alter the emotional impact of a situation, either by turning their attention toward or away from an aspect of a situation in order to change its emotional impact (attentional deployment) or deciding how to interpret a certain aspect of a situation (cognitive change, or reappraisal). Reappraisal involves assigning meanings to affective stimuli to modify their emotional impact and is effective in the reduction of negative emotion. Research suggests that antecedent and response focused strategies have different adaptive consequences. While antecedent-focused strategies lead to a reduction of the physiological response associated with the generation of stress, response-focused strategies, such as suppression, cause acute increases in the activation of such physiological reactivity (Gross, 1998).

The allocation of attention to a specific aspect of a situation is a key antecedent in the generation of meaning and emotional experience. Mindfulness skills can support this process because the mindful state is dependent on attentional control. The ability to change and maintain attention and to inhibit elaborative processing support the intention that the individuals' wandering thoughts be continuously returned to the present sensation of the breath (Shapiro, Carson, Astin, & Freedman, 2006). In the mindful state, all aspects of experience are noticed with acceptance, without being examined in depth or ruminated upon, making it less likely that individuals will entertain negative biases in their thinking, or focus on a negative aspect of the situation to the exclusion of others. Clinical research findings generally support this conclusion, though the effectiveness of interventions is prone to vary with the skill of the interventionist and participants' time commitment devoted to the intervention (Bishop, 2002; Grossman, Niemann, Schmidt & Walach, 2004). Individuals who have gone through mindfulness-based training show lower scores on measures of rumination and depression, suggesting that they are less prone to learned helplessness and the fear and avoidance of action that stifles proactive coping (Kenny & Williams, 2007). Recent research on dispositional mindfulness suggests that individuals with high levels of the natural quality of mindfulness are more likely to cope with a problem proactively rather than through avoidance (Weinstein, Brown, & Ryan, 2009). Mindful individuals seem more likely to see a stressor as a challenge rather than as an insurmountable threat.

Despite findings that mindfulness training makes individuals more resilient and less vulnerable to depressive relapse, little evidence exists that mindfulness is the active ingredient of change in these programs. Although it is believed that individuals with depression who complete mindfulness-based therapy are less likely to relapse into ruminative tendencies because of their ability to observe mental events, thoughts, and feelings in a balanced way without regarding any one negative interpretation as truth (Noelen-Hoeksema et al., 2008), there is little empirical support for this hypothesis despite evidence from multiple studies that mindfulness-based interventions are highly effective in the treatment of depression (Geschwind, Peeters, Huibers, Os, & Wichers, 2012; Kenny & Williams, 2007; Kuyken et al., 2015). As one meta-analysis shows, few clinical studies even measure the construct of mindfulness, which makes it impossible to evaluate whether individual differences in mindfulness post-treatment are responsible for clinical change (Grossman, Niemann, Schmidt, & Walach, 2004).

These gaps in the research make it difficult to determine which methods and context for the delivery of mindfulness are effective. This problem is evident when we consider the dissemination of mindfulness training through technological applications accessed through mobile phones. A recent review of mindfulness-based mobile applications showed an almost complete lack of evidence supporting the usefulness of those applications (Plaza, Demarzo, Herrera-Mercadal, & Garcia-Campayo, 2013). Knowledge and understanding of the mechanisms of how mindfulness training works is important for future intervention planning. The challenge faced by science is to learn to operationalize mindfulness so that change in mindfulness can be measured and used to validate clinical programs. To fill this gap in the literature, researchers have independently developed models of mindfulness that can be measured psychometrically. It is the aim of the next section to describe these measures.

Western Models of Mindfulness – From Simplest to Most Complex

As Kabat-Zinn (1994) notes, the mental habits of observation emphasized within mindful practice are meant to systematically train the mind, reducing evaluation of experience and stemming the tendency to ruminate. Mindfulness training is understood as a lifelong process, concerned with the cultivation of awareness, insight, wisdom, and compassion (Baer, 2003).

During the early 2000s, with this knowledge in mind, Western scientists attempted to extend the construct of mindfulness into questionnaires that could be easily understood by populations who did not have a Buddhist background. Techniques typically forming the core of Buddhist meditation, such as attention to breath, were adopted to form part of therapeutic treatment packages for clinical disorders. Mindfulness skills training was developed in the service of specific therapeutic goals, such as reduction of ruminative thinking and prevention of depressive relapse. In the context of therapeutic intervention, mindfulness has been extracted from the spiritual context, prompting criticism that it is being misapplied and misunderstood within research and clinical practice (Kabat-Zinn, 2003). Specifically, it has been put forth that definitions vary across different questionnaires, reflecting vast differences in the understanding of mindfulness among experts (Grossman & Van Dam, 2011). While mindfulness in Western research and practice has developed across a variety of models, it is unclear whether they represent any unified, underlying dimension that can be operationalized, studied, and cultivated for the improvement of health and well-being. The aim of the next section is to bridge this gap.

Most working definitions of mindfulness in use today can be placed on a continuum of complexity, from a simple state of attentiveness to one's experience (Brown & Ryan, 2003) to a complex interplay of distinct skills (Linehan, 1993). These definitions can be conceptualized with reference to Linehan's model of the 'how' and 'what' skills of mindful awareness, because it is the most comprehensive model. Her book, *Cognitive Behavior Treatment of Borderline Personality Disorder* (1993), is a therapy manual with techniques intended to help individuals with borderline personality disorder, who experience heightened emotional sensitivity, and find themselves unable to regulate intense emotional responses because they are detached from their experience. Many of these techniques share a common set of assumptions with other mindfulness-based interventions. In her conceptualization, Linehan introduces six 'core' skills, along with a number of emotional and behavioural regulation techniques, in an effort to help patients re-learn awareness of all parts of their present experience, in the interest of building self-acceptance.

Linehan (1993) delineates three 'what' qualities related to what one does when practicing mindfulness, as well as three 'how' qualities, which support the 'what' qualities and reflect how they ought to be practiced. The 'what' skills include observing, describing, and participating. Observing means being able to 'step back' from the event and to attend with awareness to thoughts, emotions, and sensations, even if it is distressing. This ability to step back keeps one from becoming over-involved and reacting to the event without awareness. For instance, this ability would make one less likely to engage in impulsive binge-drinking following an argument. The second ‘what’ skill, describing, relates to the ability to name behavioural and environmental events, without engaging directly with them. An example would be being aware of one’s own fatigue and irritation during a long wait in line, but without elaborating cognitively on the experience, thereby upsetting oneself. Participating means being able to enter completely into the activities of the current moment without separating oneself from these events and entering ‘automatic pilot’ mode. For example, a person utilizing this skill would be less likely to make the wrong turn while driving somewhere, forgetting that they had meant to detour for an errand.

The three ‘how’ skills, skills that have to do with how one observes, describes, and participates in experiences. They include taking an impartial stance, focusing on one thing in the moment, learning to focus the mind on the current moment’s activity rather than attempting to mentally multi-task, and being ‘effective’, which is aimed at using skillful means to achieve goals, for example the ability to let go of ‘being right’ in the interest of attaining a favourable outcome. A person practicing this attitude would be less likely to critically blame oneself for a past failure or short-coming, and they would be less likely to argue a point simply “for the principle of the thing” (Linehan, 1993, p. 23).

Of all these component skills, it is the first one, observing, that is represented most frequently across different models of mindfulness. Brown and Ryan (2003), for example, aim to capture only the central experience of mindfulness as a perceptual process ‘Bare attention’ is simply the state of being attentive to and aware of what is taking place in the present, and it is a state supported by self-regulatory skills. It is central to the Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003), a single-factor, 15-item scale designed for individuals with little to no previous experience with mindfulness training. It is based exclusively on items that are exhibitive of the experience of mindlessness, such as acting on 'automatic pilot' or being unaware of present-moment experience. The authors speculate that as mindless states are more common than mindful states, it may be easier for respondents to recognize and report on them.

In contrast to Brown and Ryan's simple one-factor model, Bishop et al. (2004) propose a two-component model of mindfulness. To guide their conceptualization, the authors answer two central questions: "What does one do (or refrain from doing) when being mindful?" and "How should one do it?" (p. 822). Their answer is that to enter a mindful state, one should practice dispassionate self-observation, introducing a space between one's perception and response. To achieve this, one should practice self-regulation of attention, which is dependent on skills in sustained attention, switching and inhibition of elaborative processing. According to Bishop and colleagues, as a result of this improved cognitive inhibition, greater attentional resources become available to process current experience. Bishop and colleagues stress that achieving these skills is dependent on practice, where awareness of the present moment is sustained by bringing attention back to the breath once a feeling or thought has been acknowledged. According to Bishop et al., this process must be carried out in the spirit of investigative awareness, or a stance of complete receptivity towards present-moment physical and mental experience, where all thoughts, feelings, and sensations are relevant (pp. 231). Hence, mindfulness is an orientation or a stance as well as an active process.

This idea of mindfulness as an active, dynamic process is particularly represented by the Toronto Mindfulness Scale (TMS; Lau et al., 2006), which instructs participants to reflect and rate their experience of an immediately preceding meditation session. Building on Bishop et al.'s (2004) concepts of dispassionate self-observation and investigative awareness, this scale contains two factors: curiosity and decentering. Curiosity reflects an attitude of wanting to learn more about one's experiences. Decentering, also called 'metacognitive awareness', is a shift from identifying personally with thoughts and feelings to viewing them as transient mental events independent of the self (Teasdale et al., 2003). Decentering and curiosity are qualities that must be intentionally maintained with active practice, as the practitioner continually re-asserts a commitment to bringing the qualities of kindness, curiosity, and openness to the practice. These components are believed to lead to a fundamental shift in perspective called *reperceiving*, which is facilitated by mindfulness training. According to Shapiro et al. (2006), reperceiving can be described as "a rotation in consciousness in which what was previously 'subject' becomes 'object.'" (Shapiro, 2006, p. 378). In this way, one develops increasing capacity for objectivity about one's own internal experience.

In contrast to the assessment by Shapiro and colleagues, it has been argued that mindfulness is a multifaceted construct or set of skills, of which each component should be reliably measured (Baer, Smith, & Allen, 2004). By relying on detailed behavioral descriptions of Linehan (1993) as well as existing measures, the five-component Five Facet Mindfulness Questionnaire (FFMQ) measure was constructed. Dimensions reflecting the three 'what' skills were included: *observing*, (paying attention to internal as well as external stimuli and phenomena); *describing* (naming these observed phenomena); and *acting with awareness* (engaging fully in one's activity with undivided attention). Also included were dimensions reflecting the 'how' skills: *accepting without judgment*, which reflects the awareness of immediate experiences without commentary or criticism, and *non-react,* which reflects a non-reactive stance towards internal experience (Baer et al., 2004; Baer, Smith, Hopkins, Krietenmayer, & Toney, 2006).

These distinctly delineated factors have made it possible to study the convergent and discriminant validity of the scale. For instance, the Describe scale has been found to positively correlate with emotional intelligence and life satisfaction but negatively with an inability to identify and express emotions verbally (Fitzgerald & Bellgrove, 2006). The Observe scale was positively correlated with openness-to-experience. The Non-React subscale was positively correlated with self-compassion (Baer et al, 2006). Observing, coupled with Accepting without Judgment, map onto the basic ‘what’ and ‘how’ skills of dispassionate self-observation and curious, non-judgmental receptivity. The remaining sub-scales, however, reflect behavioural and emotional self-regulation skills which both underlie and can be developed through the practice of mindfulness.

Central to all of these models, whether they represent mindfulness as a basic quality of ‘bare attention’ or as a constellation of interacting skills, is the idea of mindfulness as an active, dynamic state arising from self-regulatory processes of attention, emotion and behaviour. In each model, mindfulness is supported by an attitude of non-judgment and self-compassion, and internalized through intentional, disciplined practice. These models were developed in response to a need to understand mechanisms of change that occur during mindfulness training (Baer, 2011). The purpose of the next section will be to examine the goals, methods and effectiveness of modern therapeutic packages that emphasize mindfulness as a central skill in bringing about clinical change.

Mindfulness in the Context of Contemporary Practice

Mindfulness, in the context of contemporary psychological practice, is meant to increase insight about and improve skillful responding to mental processes that contribute to emotional distress and maladaptive behavior (Lau et al., 2006). The more widely practiced treatments, which include Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990) and Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002) train mindfulness skills through the practice of meditation, which is defined as the intentional self-regulation of attention from moment to moment (Goleman & Schwartz, 1976; Kabat-Zinn, 1982). Participants learn to focus on inner experience, such as physical sensations, thoughts, and emotions, or on aspects of the environment, such as sights and sounds. In all cases, the focus is carried out in a manner of non-judgmental acceptance. These therapeutic packages have a specific and immediate goal: the reduction of psychological discomfort among those most lacking in mindfulness, such as individuals suffering from anxiety, depression, and personality disorders.

In fact, the Mindfulness-Based Stress Reduction (MBSR) program, now perhaps the most widely known method of mindfulness training, was originally developed in a behavioural medicine setting, where it was intended to treat chronic pain and stress disorders (Baer, 2003). Groups of about 30 participants meet weekly for 2 to 2.5 hours during this 8- to 10-week course for psycho-education, instruction and practice in mindfulness meditation skills through a variety of exercises. One such exercise is the body scan, a 45-minute exercise in which attention is directed sequentially to numerous areas of the body while the participant is lying down with eyes closed. When the participant wanders into memories or emotions, the participant is instructed to briefly note the nature of the distraction but then return to focus on the breath without self-criticism. The intended outcome of this mindfulness practice is the realization that most sensations, thoughts, and emotions fluctuate, or are transient, a realization which has also been referred to as decentering, or meta-cognitive awareness (Teasdale et al., 2003).

Decentering is harnessed in Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002). MBCT is very similar to and based on MBSR, but it combines mindful meditation practice with cognitive behavioural therapy (CBT) exercises. Cognitive behavioural therapy is a highly structured intervention which emphasizes awareness of how changes in mood are brought about by interpretations of events and how those interpretations influence behaviour (Beck, 2011). MBCT was originally created for patients with major depressive disorder (Segal, Williams, & Teasdale, 2002). The goal of the MBCT program is to reduce ruminative thinking and prevent future relapses of major depressive disorder. Ruminative thinking is the opposite of decentering: it is a goal-based mode of processing, where judgments about discrepancies between one's actual and ideal state are viewed as reflections of reality, leading to unhappiness. The goal of MBCT is to switch out of this mode of processing into one that is 'decentered', or that involves an understanding that thoughts are transient mental events rather than aspects of the self (Teasdale et al., 2003). In this process, individuals learn to identify and disengage from depressogenic thoughts, redirecting attention to more objective aspects of the present moment, such as breathing, walking, or environmental sounds, avoiding the emotional distress associated with rumination (Teasdale et al., 1995). In practice, MBCT has shown efficacy in reducing risk for depressive relapse, particularly among individuals who have had three or more episodes

(Geschwind, Peeters, Huibers, Os, & Wichers, 2012). A recent study identified 424 patients with a diagnosis of recurrent major depressive disorder currently in remission, randomly assigned them to MBCT or maintenance anti-depressants, and found MBCT to be just as effective as antidepressants in preventing relapse and maintaining quality of life (Kuyken et al., 2015).

In the discussion of treatment for individuals with borderline personality disorder, Linehan (1993) proposes that the cognitive change of *decentering* may be achieved through exposure. Individuals with borderline personality disorder, who are prone to strong negative emotional states, are also afraid of their emotions. Prolonged observation of current thoughts and emotions, without trying to avoid or escape them, should encourage the extinction of fear responses and avoidance behaviors previously elicited by these stimuli. In Dialectical Behaviour Therapy (DBT), which includes a wide range of cognitive and behavioural treatment procedures, the main focus is to help individual regulate and tolerate strong negative emotions and to develop better behavioural coping skills. There is also a strong emphasis on self-acceptance before change can occur (Linehan, 1993). If the individual accepts that negative emotions like sadness and fear may occasionally occur, and that they are time-limited and not dangerous, it becomes easier for the individual to tolerate these states without turning to maladaptive coping mechanisms such as emotional avoidance or self-distraction through substance abuse (Baer, 2003).

In sum, all major mindfulness treatments aim to develop *decentering* with an attitude of acceptance and impartiality. As recent meta-analyses show, MBSR training leads to a reduction in chronic pain and mood-related symptoms (Grossman, Niemann, Smith, & Wallach, 2003), while MBCT prevents depressive relapse (Fjorback, Arendt, Ornbol, Finch,

& Walach, 2011). The induction of mindful self-observation has many salutary effects, including symptom reduction and improved well-being (Brown, Ryan, & Creswell, 2007). However, we know little about what accounts for these favourable psychological health outcomes, and to what degree *decentering*, or *reperceiving*, is to be credited. It is known that mindfulness training does not work under all circumstances, nor does it work for all people. The appropriate mindfulness intervention must, therefore match the client's therapeutic goals, clinical problems, and symptom severity (Dimidjian & Linehan, 2003). Currently existing reviews fail to answer how this is to be done systematically. Grossman et al. (2004) report that none of the mindfulness intervention studies reviewed in their meta-analysis actually evaluated for change in the construct of mindfulness. Further study on how the active ingredients of mindfulness enhance attentional and emotional regulation is needed. The next section will discuss how components of mindfulness may be represented and examined through research methods.

The Mindfulness Process and its Concomitants

As previously described, mindfulness is a dynamic process dependent on the self-regulation of attention. In a mindful state, physical and mental events are noticed as they arise, but are not evaluated or interpreted. Once the emotion, thought, or sensation has been acknowledged, the focus on the breath is re-established (Bishop, 2004). As a result, the cognitive response (rumination), with attending emotional and physiological arousal, is stemmed. With practice, this ability is applied more frequently in daily life. As the individual becomes increasingly able to perceive one's identity as separate from the flow of transient experience, simply being with it rather than being defined or controlled by it, the individual becomes less likely to perceive threat when it is not there or if it has already passed, which protects against the unnecessary activation of the cascade of emotional and physiological events of the "fight or flight" response (Shapiro et al., 2006). Although mobilization of resources to face a real challenge is behaviourally healthy, the repeated decision to mobilize for threat in benign or ambiguous situations can result in psychological and physical wear and tear over time (McEwen, 1995). For instance, individuals with hostile attribution bias tend to erroneously perceive hostile motives in others' actions, which leads them to become hypervigilant and to mobilize physiologically to fight perceived threat on a constant basis (Heppner et al., 2008). There is a negative relationship between mindfulness and hostile attribution bias (Heppner et al, 2008), which suggests that mindfulness protects against this tendency to perceive threat unnecessarily.

A mindful state is characterized by dispassionate self-observation, "introducing a space between one's perception and response" (Bishop, 2004, p. 204), decreasing attentional load and freeing information processing resources. With these resources now available, the individual is more likely to respond calmly and flexibly with proactive coping skills rather than reacting impulsively or with avoidance – 'the fight-or-flight response.' There are emotional, physiological, and behavioural outcomes to this process, which can be measured and studied systematically through experimentally inducing the experience of stress, and then measuring the response to and recovery from that stress.

One way to manipulate stress processes in a laboratory setting is through brief mindfulness training. Participants are typically taught to practice mindful self-awareness for a short period of time, often by focusing on the breath (Burg & Michalak, 2012). Typically these designs focus on self-report and interview measures of cognitive and emotional appraisal and mindfulness (Feldman, Greeson, & Senville, 2010; Prasad, Wahner-Roedler, Cha, & Sood, 2011; Sauer & Baer, 2011). Further research with emotionally salient tasks and an induction of self-regulation in response to a personally relevant stressor is needed to illustrate the link between self-rated mindfulness and flexibility of response to situational demands. Previous findings suggest mindful individuals' ability to cope more calmly and effectively is supported by the better management of attentional resources and more objective and holistic perception of situations. Management of attention affects cognitive appraisal, which is linked to an emotional reaction. It is the aim of the subsequent section to elaborate on the meaning of cognitive and emotional self-regulation, and how it can be represented by specific, measurable indices.

Decentering and the Fight or Flight Response: Cognition and Emotion

Decentering, or *reperceiving*, is analogous to and interdependent with the physiological self-regulation process. *Decentering* is associated with a more flexible physiological response to stress, perhaps because in the absence of rumination, an individual's perception of daily experience is more objective, and fewer stimuli are perceived as actually threatening (Borkovec, 2002). This is not a new idea, but a hypothesis that has been examined for both state (induced) mindfulness, as well as trait mindfulness. Jha et al. (2007) found that both novice and experienced meditators showed improvements in sustained attention relative to controls following an eight-week MBSR intervention. Correlations have been established between trait mindfulness and improved selective attention, inhibitory control, and cognitive flexibility (Moore & Malinowski, 2009), all of which are cognitive processes that have physiological underpinnings (Thayer & Lane, 2000).

These skills of attention support more adaptive processing of emotion. Greater flexibility in attention regulation is associated with a more objective cognitive appraisal of situations or events. To cope well emotionally and behaviourally, the individual needs to read the relevant environmental cues and select relevant information while ignoring irrelevant information (Thayer & Lane, 2000). But as they make decisions, individuals may make automatic judgements based on pre-existing schemas and biases, such as hostile attribution bias. In doing this, they run the risk of reacting emotionally based on a distorted or incomplete view of reality (Brown, Ryan, & Creswell, 2007). Schemas develop gradually and become implicit with time, though they are automatically activated without conscious intent in stressful situations. If they are maladaptive schemas, they may encourage people to filter information in a biased way, giving more weight to some types of information than to others (Beck, 2011). In this way, a person may expect to fail a test even though they have been previously successful, perhaps because they have a core belief, for example, of not being smart or not having academic ability.

Cognitive appraisal elicits emotional reactivity, according to the appraisal theory of emotion (Smith, Haynes, Lazarus, & Pope, 1993). Situational judgment precedes emotions (Lazarus, 1982). For instance, blaming oneself precedes guilt, while blaming others precedes becoming angry (Smith & Kirby, 2001). As mentioned above, mindfulness as a pre-reflexive state reduces a person's attachment to pre-existing schemas. Individuals with higher mindfulness self-ratings show better emotion reappraisal skills during emotion appraisal tasks (Modinos, Ormel, & Aleman, 2010), suggesting that as individuals reframe their interpretations of events, stimuli lose their potency to create fear and anxiety. During an affect labelling task, stronger self-rated dispositional mindfulness skills were associated with greater activation of pre-frontal cortical regions, which control the allocation of attention and working memory resources, as well as attenuated responses of the amygdala, which is associated with strong negative emotionality and the fear response (Creswell, Way, Eisenberger, & Lieberman, 2007). In their research on compassion meditation, Lutz, Brefczynski-Lewis, Johnstone and Davidson (2008) also found greater activation of brain regions underlying the regulation of emotions and feelings (e.g., insula, anterior cingulate cortex) and indicators of autonomic reactivity (e.g., pupil size) in response to emotional stimuli while participants practiced meditation. Greater activation was found among more experienced meditators, supporting the authors' hypothesis that *decentering* is associated with stronger use of those regions and with improved ability to down-regulate negative emotionality (Lutz et al., 2008). Recent research on functional brain imaging and connectivity sheds light on the influence of mindfulness skills on emotional regulation at the neuroanatomical level. These dynamic self-regulatory changes are reflected in autonomic changes, which can be measured directly through physiological indices. It is the aim of the next section to review these findings.

The Mindful Brain and Emotional Regulation

Recent reviews of brain imaging research suggest that mindful individuals are better at inhibiting evaluative processing in cortical regions and the amygdala. Additionally, they are better able to divert attentional resources towards a limbic pathway involved in present-moment sensory awareness, which includes the anterior cingulate cortex (ACC), the insula, the thalamus, and primary, as well as associative, sensory regions (Farb, Anderson, & Segal, 2012). Studies of functional brain imaging suggest that mindfulness is associated with increased brain connectivity between the anterior cingulate cortex (ACC) and limbic and sensory regions (Farb et al., 2007; Kilpatrick et al., 2011; Lazar et al., 2005). Because the ACC is involved in attentional regulation, on a cognitive level, effective recruitment of this pathway should parallel a reduction of perseverative rumination and elaborative processing of negative schemas, as well as redirection of attention to present moment experience, including enhanced awareness of sensory and emotional events. There is empirical support for such cognitive change, as short-term mindfulness interventions have resulted in increased ability to perceive sensory stimuli as well as improved attentional focus (Jha et al., 2007).

This model of the dynamic process of mindfulness is based on preliminary results from brain imaging research. For instance, in a study using fMRI scans following an 8-week MBSR course, Kilpatrick and colleagues (2011) found evidence of increased integration of primary sensory cortices with prefrontal areas among 17 meditators who were compared to 15 waiting list controls. Similar results were reported by Farb et al. (2007), who found that among 20 individuals who had taken part in an 8-week MBSR course, engagement in open, present-moment attention was associated with reductions in midline cortical activation but increased activation of right-lateralized insula and secondary somatosensory cortices during fMRI scanning. Lazar and colleagues (2005) observed increased grey matter volume in interoceptive and sensory regions such as the insula, somatosensory cortex and parietal regions among 20 individuals with experience in insight-oriented meditation. Results from these studies are difficult to integrate because they are small and preliminary, and data on brain activity is collected under a variety of conditions, yet there is evidence to suggest increased recruitment of brain areas involved in sensory and emotional processing, as well as a reduction in the involvement of certain areas associated with elaborative cognitive processing.

The improved connectivity between certain areas of the cortex, especially the ACC, and limbic and sensory areas, is important in the regulation of emotional processing.

Specifically, the ACC supports the process of mindful open awareness, because when distracting external events or memories intrude upon this process, it is the function of the ACC to maintain attention by implementing top-down regulation of emotion and attention (van Veen & Carter, 2002). On a physiological level, output of the ACC is carried by the preganglionic sympathetic and parasympathetic neurons, which convey these impulses to the organs of the body, including the skin, heart, and lungs. This top-down regulation of physiological processes initiates a cascade of changes mediated by the autonomic nervous system, which are reflected in indices of peripheral nervous system activity such as skin conductance, respiration, blood pressure, HR, and HRV (Ross, 1980). These processes, and their intensity and duration, reflect changes in physical and emotional homeostasis (Appelhans & Luecken, 2006; Ross, 1980).

Recent research has turned to the measurement of peripheral nervous system indices to better understand how meditators and individuals self-regulate physically and emotionally. Before examining this line of research in depth, it is worthwhile to look at the workings of the autonomic nervous system, with emphasis on indices of nervous system functioning and how their changes may reflect emotional arousal.

Autonomic Nervous System (ANS) Activity and its Indices

The ANS functions to maintain homeostasis within the body through regulation of major organs, namely the contraction of smooth and cardiac muscle and the secretions of endocrine glands (Ross, 1980). The autonomic nervous system regulates the body through the interplay of its two major divisions: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS) (Ross, 1980). The function of the SNS is to regulate a variety of functions that reach their greatest intensity as the body mobilizes for threat, during the “fight-or-flight” response, which prepares the organism to respond during a physical or emotional challenge, such as a difficult interview. Sympathetic reactions include energy-consuming activities such as increased heart rate and cardiac output, increased metabolism, and mobilization of fuel stores in the body (Ross, 1980). Parasympathetic reactions, in contrast, are energy conserving, and include the slowing down of heart rate as well as increased salivation and digestion. The function of parasympathetic reactivity is to return the body to equilibrium after the threat has passed (Ross, 1980; Korner, 2007).

Both the SNS and the PNS include *afferent* fibers that carry impulses toward the central nervous system (CNS) and *efferent* fibers conveying impulses away from the CNS to the effector organs, such as the heart and lungs (Ross, 1980). In top-down regulation of cardiovascular functioning, cortical structures relay information to the cardiovascular control centre (CCC) in the medulla, which monitors arterial blood pressure (BP) and regulates breathing (Korner, 2007). The medulla integrates this top-down input with information about changes in the body from the afferent baroreceptors, chemoreceptors, and muscle sensory receptors (Ross, 1980). High-pressure baroreceptors are sensitive to stretch in the aorta and carotid arteries, while low-pressure baroreceptors respond to stretch in the atria of the heart. Their main function is to regulate arterial pressure and blood volume (Ross, 1980). Chemoreceptors are located in the aortic and carotid bodies and are responsible for detecting low oxygen levels as well as high carbon dioxide levels in arterial blood, and their main function is to regulate ventilation (Ross, 1980). Muscle sensory receptors consist of mechanoreceptors (which detect stretch in contracting muscle) and metaboreceptors (which respond to metabolic changes within muscle tissue), which are activated mainly during exercise and send signals to the CCC (Middlekauff et al., 2004) (see Figure 1). The signals sent to the CCC via afferent receptors result in adjustments to the ANS to maintain cardiovascular and respiratory homeostasis (Ross, 1980; Korner, 2007).

Via hormonal mechanisms, the PNS and SNS work synchronously to influence heart rate (HR) and arterial BP. Blood pressure can be adjusted by slowing or accelerating heart rate respectively to decrease or increase the amount of blood pumped by the heart or by constricting or widening the diameter of blood vessels (Ross, 1980). Although the heart has an independent intrinsic rhythm, this rhythm is influenced by the ANS to maintain homeostasis (Ross, 1980). During mobilization of the body during periods of stress, vagal activity is suppressed and sympathetic discharge increases to exert influence on the heart through reduced acetylcholine concentration and increased norepinephrine concentration around the pacemaker cells of the heart. Removing vagal influence also leads to dilation of the bronchi and quickened breathing. Sweat glands become active, which is another index of sympathetic activity (Boucsein, 2012). Once the threat is over or has been dealt with through coping, physiological down-regulation returns the body to a state of baseline rest. Parasympathetic activity via the vagus nerve is reinstated, and heart rate as well as respiration slows. Down-regulatory influence on the heart is exerted through the constant release of acetylcholine from the vagus nerve endings in the sinoatrial node, which slows down heartbeat. Stimulation of the vagus nerve also causes breathing to slow (Ross, 1980). The activity of the PNS also increases the widening of blood vessels, which results in lower BP. Parasympathetic activation represents down-regulation of physiological arousal, and is a direct indicator of self-regulatory activity (Porges, 1995).

BP and HR also influence each other through a feedback loop independent of cortical control. The BP information is fed back to the medulla via baroreceptors located in artery walls. If BP drops too low, the medulla responds by increasing HR and the amount of blood pumped by the heart to increase the flow of blood (see Figure 1 below). This process breaks down in those with cardiovascular dysfunction, when the heart is unable to pump blood sufficiently to maintain the body's needs (Dorland's, 2011). Literature has linked cardiovascular dysfunction to high cardiovascular reactivity in response to stress, which is also believed to reflect poor emotional self-regulation (Carroll, Phillips, Der, Hunt, & Benzeval, 2011)

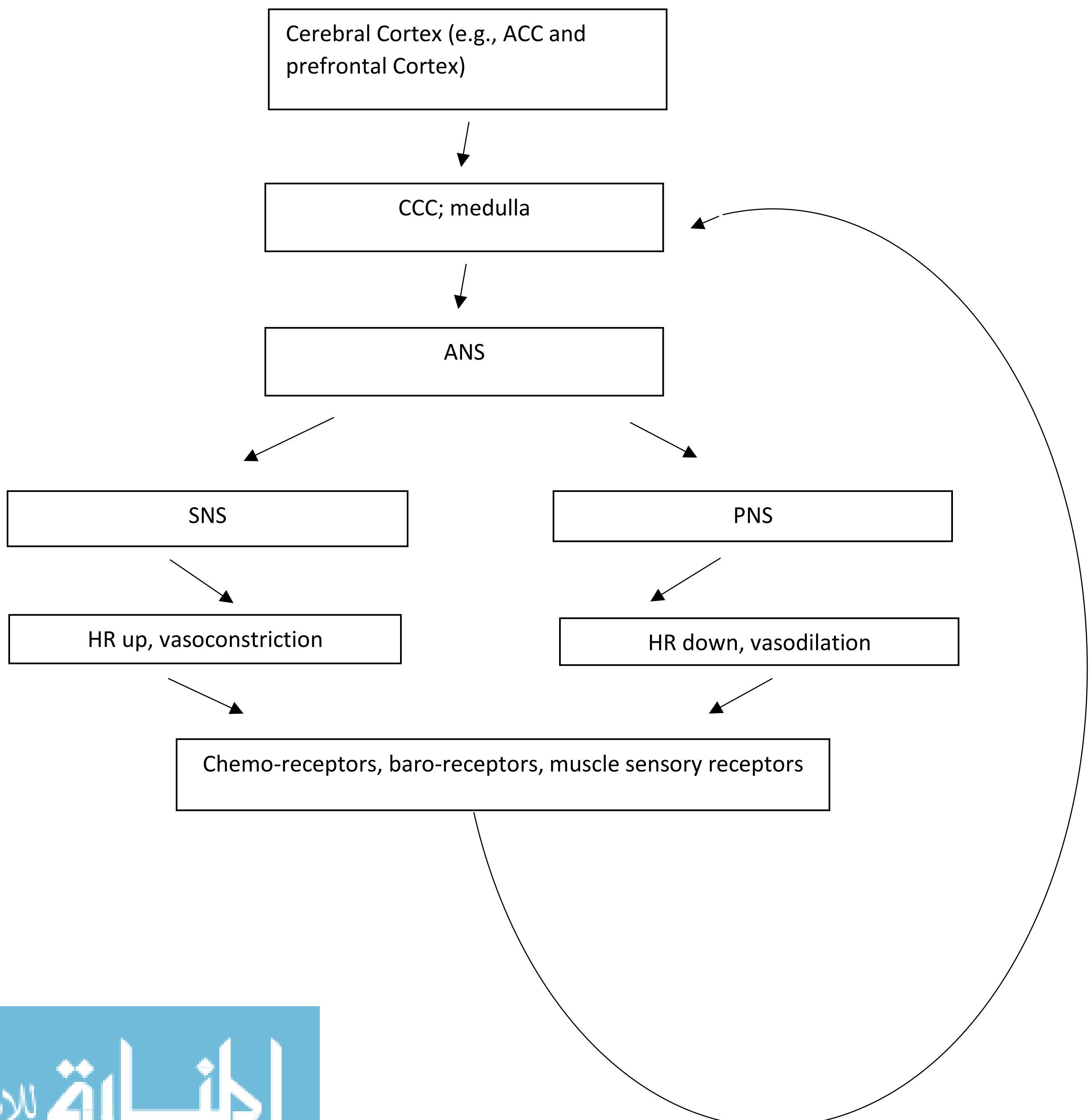

Figure 1 . The integration of central and peripheral nervous system mechanisms responsible for the regulation of arterial blood pressure. ANS; autonomic nervous system, PNS; peripheral nervous system, SNS; sympathetic nervous system, HR; heart rate. This figure has been adapted from Gregory, M. (2012). *The effects of isometric handgrip training on carotid arterial compliance and resting blood pressure in postmenopausal women*. (Masters thesis). University of Windsor, Windsor.

ANS Functioning, Adaptability, and Heart Rate Variability

Emotional regulation depends greatly on the individual's ability to transition between states of high and low autonomic arousal (Gross, 1998). This ability is dependent on how quickly the ANS can adjust heart rate and blood pressure (Appelhans & Luecken, 2006). Autonomic flexibility is reflected uniquely in heart rate variability (HRV), which is a measure of the interplay of sympathetic and parasympathetic influences on the sinoatrial node of the heart. As the activation of the sympathetic fibers increases the firing rate of the sinoatrial node and heart rate speeds up, the time between heart beats (inter-beat interval) becomes shorter. In contrast, when activation of the parasympathetic fibers inhibits the activity of the sinoatrial node, causing heart rate to slow down, the inter-beat intervals become longer (Appelhans & Luecken, 2006). "This interplay of sympathetic and parasympathetic (vagal) outputs at the sinoatrial node produces the complex beat-to-beat variability characteristic of a healthy, adaptive organism" (Thayer & Lane, 2000).

Parasympathetic regulation is an indicator of the ability to regulate emotions flexibly. The greater the degree of parasympathetic engagement, the more pronounced the acceleration and deceleration of their heart beat, also expressed as HRV. High HRV reflects a flexible autonomic nervous system that is adaptive, as it enables the generation of appropriate emotions and facilitates rapid adjustment to momentary situational demands (Appelhans & Luecken, 2006).

In contrast, failure to inhibit sympathetic functioning when needed can be a sign of maladaptive ANS processes and a predictor of poor behavioural flexibility. As will be explained in the next section, lack of effective autonomic regulation, reflected in high sympathetic activation and low parasympathetic activity, is a characteristic of affective disorders.

ANS Dysfunction and Emotional Regulation

Well-known and commonly used indices of emotional regulation and psychological discomfort include HR and BP. In humans under conditions of prolonged stress, chronically elevated HR and BP have been observed as a consequence of elevated SNS activity (Krantz & Manuck, 1984). Individuals known to have poorer ability to down-regulate negative emotional arousal, such as those with generalized anxiety disorder, also show higher resting HR and BP, which is potentially damaging to cardiovascular health in the long run (Whitehead, Blackwell, DeSilva, & Robinson, 1977). Affective disorders have also been linked to poor parasympathetic control of HR (Watkins, Grossman, Krishnan, & Sherwood, 1998), and, consequently, attenuated HRV (Agelink, Boz, Ullrich, & Andrich, 2002).

ANS Functioning and Mindfulness

Mindfulness practice has shown benefits for psychological health in improved mood and coping (Grossman, Niemann, Schmidt, & Walach, 2004). It has been suggested that mindful individuals learn to disengage from emotional distress by redirecting attention to current aspects of experience, thereby avoiding rumination, which is the elaborative processing of negative meanings (Teasdale et al., 1995). If physiological indices reflect the ability to flexibly adapt emotionally, mindful individuals would be expected to show lower BP and HR and greater autonomic balance.

A few studies examining relations between mindfulness and BP suggest that individuals show an attenuation in resting BP or HR following mindfulness-based training across a variety of populations, including cancer patients (Carlson et al., 2007; Campbell et al., 2007), diabetics (Rosenzweig et al., 2007) and healthy young adults (Tang et al. 2009). Ditto, Eclache and Goldman (2006) compared mindfulness meditation, progressive muscular relaxation, and control group after a four-week period, and found that none of the interventions reduced BP, either immediately or after the four-month period. More recent research suggests that cognitive variables may mediate the relation between mindfulness and cardiovascular markers of stress. In a randomized, controlled study by Campbell et al. (2007), treatment condition participants, consisting of 52 women with a variety of cancer diagnoses, demonstrated higher levels of mindful attentiveness and decreased ruminative thinking following an 8-week MBSR program. Participants' blood pressure was measured at pre- and post-treatment. Although MBSR group participants demonstrated no changes in BP relative to the control group, decreased ruminative thinking was correlated with a decrease in systolic blood pressure. Campbell et al. (2007) suggest that since rumination may exacerbate the physiological arousal that accompanies emotional distress, mindfulness may have a role in stemming rumination and thereby decreasing blood pressure.

A small body of research has begun to examine the relation between mindfulness and autonomic function. In those studies, outcome variables that identify autonomic function are obtained through spectral analysis (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). In spectral analysis, variations in HR are sub-divided into a non-harmonic (or fractal) component and a harmonic component. The harmonic component of the spectrum is further sub-divided into high frequency HRV (HF-HRV) rooted in vagal HR modulation, while the low-frequency HRV (LF-HRV) is rooted in both sympathetic and parasympathetic heart rate modulation (Task Force, 1996). One study found that mindfulness meditators, when compared to a randomized control group, demonstrated decreased sympathetic activity marked by lower skin conductance response and HR, and increased parasympathetic activity, marked by HRV (Telles, Mohapatra, & Naveen, 2005). Another study utilizing mindfulness meditation, using an Integrative Body–Mind Training (IBMT) protocol among 80 Chinese undergraduates found that mindfulness training led to more adaptive physiological states compared to participants in a relaxation condition. This included reduced HR and skin conductance response, both indices of sympathetic functioning, as well as greater HRV, and index of parasympathetic functioning during and following IBMT in comparison with the relaxation group (Tang et al., 2009). As it is a direct result of the self-regulatory activity of the ACC, whereby distractions and mental elaboration is inhibited, HRV may be considered to be an index of cognitive inhibition of elaborative processing and rumination and down-regulation of emotional reactivity (Lane et al., 2009). Hence, it is not surprising that mindful individuals with well-developed decentering skills should show high vagal tone, though only preliminary findings exist to support this hypothesis.

Keeping in mind that self-regulation is dynamic, an appropriate way to represent this process experimentally is through the induction of self-regulation in response to an emotionally-salient task, such as anger induction or biographical recall. This is a popular practice which has found favour with scholars who want to understand how humans react to stress. In fact, the emotional nature of the task profoundly affects the duration of the cardiovascular response to a stressor, which is followed by down-regulation, or ‘cardiovascular recovery’ and return to baseline (Glynn, Christenfeld, & Gerin, 2002). Specifically, the ability to engage parasympathetic reactivity at baseline and during the ‘cardiovascular recovery’ period, reflected by HRV, are regarded as well-established indices of capacity for self-regulatory effort (Lane et al., 2009; Segerstrom & Nes, 2007). However, most studies on mindfulness and physiological states investigate changes in resting autonomic function.

Summary

In sum, the reviewed literature indirectly suggests self-reported mindfulness may be associated with attenuated, or at least more selective, emotional and physiological responding. However, there is little evidence to support this hypothesis directly in the scientific literature. Most commonly, mindfulness is assessed solely through self-report questionnaires and not with psychophysiological measurements. Chapter 2 and Chapter 3 of this paper will discuss how individual differences in mindfulness can translate into individual differences in emotional and psychophysiological response to a personally relevant event with multifaceted assessments. Chapter 3 will expand on how self-report scores of emotional dysregulation and current depression and anxiety symptoms can be used for the purpose of discriminant and convergent validation of the construct of mindfulness among university-age students. Chapter 4 will discuss how mindfulness skills may improve coping through facilitating effective appraisals of the environment and the self. The introductory sections for the next three chapters are intentionally somewhat overlapping because each chapter is intended as a stand-alone study and therefore must have an independent literature review.

Note to the reader

This document contains three separate, but related studies as well as introductory (chapter 1) and summary (chapter 5) chapters. Chapters two, three, and four are intended to be manuscripts submitted to peer-reviewed journals for potential publication shortly after the dissertation is defended and revised. Thus, it should be expected that there are sections with substantial overlap from one chapter to the next. This format is intentional and falls in line with the dissertation supervisor's standard practice with her doctoral students.

CHAPTER 2

Personally-Relevant Events, Mindful Self-Regulation, and the Response to Stress

The aim of the study described in this chapter is to help establish the validity of mindfulness as a method of promoting adaptive self-regulation of emotion and behaviour. This chapter will discuss how individual differences in mindfulness are reflected in healthy physiological self-regulation, with emphasis on how this can be demonstrated experimentally. Background concepts and definitions relevant to the construct of mindfulness and its measurement will be explained. Subsequently, it will be discussed how the quality of mindfulness, captured through self-report measures, should be reflected in resilient psychophysiological self-regulation in response to a challenging, personally relevant event. It will also be explained how data collected during a short mindfulness induction exercise can be used to understand the mechanisms of mindful awareness.

Mindfulness and Self-regulation of Attention and Emotion

Mindfulness is most commonly defined as the state of being attentive to and aware of what is taking place in the present without judgement (Kabat-Zinn, 2003). Though the cultural origins of mindfulness can be traced back to Buddhist teachings, secular practitioners have co-opted mindfulness as a natural, inherent quality present in all humans to some degree (Kabat-Zinn, 1990; Brown & Ryan, 2003). According to meditation experts, mindfulness is a dynamic, active process of remaining aware of moment-to-moment experience by repeatedly directing attention away from distractions without self-criticism (Bishop, 2004). Hence, mindfulness is believed to be dependent on attentional self-regulatory processes, such as attentional switching and the ability to inhibit distractions (Bishop, 2004), and this idea has empirical support. For instance, Moore and Malinowski (2009) compared 25 meditators and 25 non-meditators on self-rated mindfulness, performance measures of selective attention (such as the d2-test) and inhibitory control and cognitive flexibility (such as parts of the Stroop task). They found that high self-rated mindfulness was associated with high processing speed as well as good attentional and inhibitory control. Jha, Krompinger, and Baime (2007) found that following MBSR training, young adult participants showed an improved orienting response when subjected to the attention network test, a performance task devised to identify functioning of subsystems of attention, in comparison with control participants.

According to researchers, mindfulness, which may exist as a natural quality among meditation-naïve individuals, can also be developed through meditation practices to bear positive effects for health and well-being. One of the first things mindfulness students learn is the practice of focusing attention to the act of breathing (Burg & Michalak, 2011; Prasad, Wahner-Roedler, Cha, & Sood, 2011). Students cultivate moment-to-moment awareness as they learn to focus attention to physical sensations such as breathing, or, through the more finely-grained ‘body scan’ exercises, to physical sensations from specific body parts or feelings of respiration (Kabat-Zinn, 1990). Once in this mindful state, physical and mental events are noticed as they arise, but are let go of as soon as they enter awareness, without being evaluated or interpreted. Once the emotion, thought, or sensation has been acknowledged, attention returns to the breath (Bishop, 2004). As an outcome of this process, a dispassionate state of self-observation results, one which introduces a space between thought and action. This state is referred to as *decentering* (Linehan, 1993; Teasdale et al., 2002).

The state of decentering is associated with improved ability to regulate emotions. Because all mental events are acknowledged in awareness in a time-limited manner, without painful stimuli being avoided or denied, individuals are likely to learn to tolerate these states. Once negative emotions are understood as transient and not dangerous, they should become easier to face due to the extinction of fear response (Linehan, 1993). As individuals avoid evaluating or identifying personally with negative thoughts and feelings, negative emotionality is reduced (Kabat-Zinn, 2003; Teasdale et al., 2002).

Although there are well-developed theories to explain the mechanism of how mindfulness practice leads to improved mental health, little empirical evidence exists to support that mindfulness is the active ingredient responsible for change among individuals undergoing mindfulness-based therapy. The next section will discuss this problem with emphasis on methods of measuring mindfulness.

Psychometric Measurement of Mindfulness: Issues of validity

During the 1980's and 90's, Western researchers and clinicians introduced mindfulness practice into mental health treatment programs, such as Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002) and Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990). These programs teach mindfulness through the practice of meditation, and as recent reviews and meta-analyses show, they lead to benefits for practitioners such as reduction in pain and mood-related symptoms (Grossman, Niemann, Smith, & Wallach, 2011) as well as prevention of depressive relapse (Fjorback, Arendt, Ornbol, Finch, & Walach, 2011). However, the development of research methods to measure mindfulness change and its benefits has lagged behind (Bishop, 2002; Baer, 2003).

To address this, a number of mindfulness scales were developed. Measures such as the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) and the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) conceptualize mindfulness as a trait-like quality or general tendency. Though self-report data are a valuable starting point for understanding many psychological processes, self-report measures may be an inaccurate reflection of the individual's true states due to cognitive biases, such as socially desirable responding and because individuals are vulnerable to certain blind spots or misperceptions when asked to report on their own behaviour (Austin, Gibson, Deary, McGregor, & Dent, 1998). Self-report measures of mindfulness like the MAAS are no different in this respect. For instance, studies show that undergraduate students tend to reject items that reflect mindlessness and favour items that seem to reflect mindfulness, which is a problem when no measurement of mindfulness independent of this bias is included in the methods (Grossman & Van Dam, 2011). Grossman and Van Dam (2011) also point out that the degree to which participants value a certain item will influence the extent to which they will endorse that item. Participants may be more likely to endorse certain items, such as "I'm good at finding the words to describe my feelings" (FFMQ; Baer et al., 2006), simply because that is clearly a positive quality, and because they might want to demonstrate to others or to themselves that they possess it.

Due to these biases and psychometric constraints, the questionnaire method is limited within the field of mindfulness. Validation of questionnaire methods with an objective, external referent analogous to the experience of meditation is crucial. In addition, there is a problem with how self-rated questionnaires try to tap the experience of mindful awareness or *decentering*, in that the questionnaires attempt to capture mindfulness in descriptions referring to a person's general tendencies, as though mindfulness were a static trait (Grossman & van Dam, 2011). But, as previously mentioned, mindfulness is supported by attentional self-regulatory processes (Bishop, 2004).

Such self-regulatory changes are rooted in the activity of the autonomic system. For this reason, physiological indices represent an objective way to measure emotional responding, and would be an effective external referent to validate whether mindfulness is associated with healthy self-regulatory changes. If mindfulness self-ratings were found to correspond to changes on a physiological level, the validity of mindfulness measures would be supported. The next few sections are designed to describe these biological indices.

Mindfulness, Emotionality, and Indices of Physiological Self-Regulation

Cardiovascular variables like blood pressure (BP) and heart rate variability (HRV) are well-suited to the measurement of physiological changes related to mindfulness/mindful effects on health because they are a direct measure of changes in autonomic arousal. There is emerging literature to indicate that training in Mindfulness-Based Stress Reduction (MBSR) (Ditto et al., 2006; Campbell et al., 2007; Carlson et al., 2007; Rosenzweig et al., 2007) as well as short-term mindfulness training (Tang et al., 2009; Zeidan, Johnson, Gordon, & Goolkasian, 2010) have shown benefits for cardiac functioning at rest. However, almost no studies exist on how mindfulness may affect physiological and emotional self-regulation. Self-regulation is a dynamic process and is best observed when it occurs in response to a personally relevant, emotionally taxing event, such as being evaluated by others (Dickerson & Kemeny, 2004) or in response to the recall of a personally relevant event (Velasco & Bond, 1998).

Cardiovascular and skin conductance response measures effectively reflect individual differences in self-regulation during and after personally-relevant tasks because BP and HR noticeably increase under stressors which induce vigilance, or the alert, watchful observation of the environment (Schneiderman & McCabe, 1989; Kassam & Mendes, 2013).

Skin conductance response (SCR)

Skin conductance response, a measure of phasic changes in sweat gland reactivity, which is sensitive to threat and the orienting response, is also an effective reflection of self-regulatory autonomic activity. Its origin lies solely in the sympathetic branch of the autonomic nervous system, making it a pure measure of arousal in response to stress or challenge. It is believed that increased SCR reflects repressive coping when faced with a novel or challenging experience (Barger, Kircher, & Croyle, 1997). On the other hand, mindfulness among Zen meditation practitioners has been associated with reduced activation of skin conductance response during stress (Austin, 2006). SCR is mainly used as a measure of initial arousal during stress, but it has also been demonstrated that individuals with a history of poor emotional self-regulation or history of trauma experience higher non-specific skin conductance responses following recovery from psychosocial stress, suggesting that sympathetic involvement persists longer than necessary for these individuals (Romero-Martinez, Williams, Gonzalez-Bono, & Moya-Albiol, 2013). SCR is a commonly used measure of sympathetic functioning, and it is often used as an outcome measure in conjunction with BP.

Blood Pressure

Arterial BP is an appropriate psychophysiological measure of changes in reactivity in response to an emotionally demanding task because BP noticeably increases under stressors which induce vigilance, or the alert, watchful observation of the environment (Schneiderman & McCabe, 1989; Kassam & Mendes, 2013). Arterial BP is a tightly regulated system, with local, neural and hormonal components working to maintain homeostasis in response to challenging events (see Figure 1). Patterns of BP reactivity can distinguish between those that react to challenging events adaptively and those who interpret these events as threats. When individuals react effectively to a challenge, sympathetic reactivity is engaged, which increases HR and cardiac output, or output of blood by the heart per minute. However, simultaneously, the release of epinephrine by the medulla oblongata results in decreased total peripheral resistance, or the resistance to flow that must be overcome to push blood through the circulatory system (Mendes, Reis, Seery, & Blascovich, 2003; Dienstbier, 1989). Blood vessels widen, which decreases BP and leads to quicker cardiovascular recovery. In contrast, when individuals react to a demanding event as they would to a threat, increased cardiac output occurs accompanied by narrowed blood vessels, which increases total peripheral resistance and raises BP, because greater systolic BP is needed to overcome total peripheral resistance (Blascovich & Tomaka, 1996). In this case return to resting state blood pressure following a stressful task, is slower and takes longer, and may be reflected in declining performance on tasks (Dienstbier, 1989).

Arterial BP, or the force exerted by blood against the vessel walls, is most commonly defined by two numbers: systolic and diastolic BP, which are effective indices of cardiovascular reactivity typically used to record autonomic functioning during stress (Kemeny et al., 2012). Systolic BP (SBP) is the pressure exerted by blood on the arterial walls during the contraction phase of the cardiac cycle (Ross, 1980). In order for blood to flow, SBP must overcome the resistance created by the arteries (Ross, 1980). Diastolic BP (DBP) is the pressure that the blood exerts on the arterial walls during the relaxation phase of the cardiac cycle (Ross, 1980). Most commonly, the SBP/DBP ratio is used to represent ABP, with ≤ 120 mmHg/ 80 mmHG considered normal (Pickering et al. 2005; Hypertension Canada, 2017).

Although BP and HR effectively reflect reaction to and down-regulation following stressful tasks, they fail to reflect the autonomic origin of this reactivity. The indices of BP and HR are the product of the interplay of the excitatory sympathetic nervous system (SNS) and the inhibitory parasympathetic nervous systems (PNS), the two branches of the autonomic nervous system (ANS). SNS activity is associated with the fight or flight response following the identification of threat, while PNS activity is associated with down-regulation after the threat has been dealt with (Thayer & Lane, 2000; McCraty et al., 1995). The antagonistic interplay of these two systems produces varying degrees of physiological arousal (Appelhans & Luecken, 2006). For example, an increase in HR could arise from increased SNS activity or from decreased PNS activity (Appelhans & Luecken, 2006).

For this reason, some studies on cardiovascular reactivity and recovery supplement BP and HR with measures of HRV, which reflects the variability in the inter-beat interval, or the distance between individual heartbeats. At any given moment, the inter-beat interval varies as a function of shifting SNS and PNS (self-regulatory) influences, which respond to changes in the breathing cycle (Thayer & Lane, 2000). Inhalation results in the withdrawal of PNS impulses, due to which the HR increases. Exhalation reinstates PNS influence on the heart, resulting in a HR decrease (Appelhans & Luecken, 2006). Effective self-regulation is dependent on an individual's ability to rapidly engage PNS responding to adjust autonomic arousal (Gross, 1998). Increased PNS input results in more pronounced acceleration and deceleration of heart beat, as well as greater variability of intervals between heart beats, that is, higher HRV (Segerstrom & Nes, 2007). Conversely, lack of change in HR during the breathing cycle is consistent with weak parasympathetic impulses.

HRV can be analyzed to separate the inter-beat interval out into high frequency and low frequency components (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). High frequency HRV reflects parasympathetic control of the heart (Berntson et al., 1997), and is considered an index of the self-regulation of emotion and attention (Thayer & Lane, 2000). Low frequency HRV reflects combined SNS and PNS influences (Berntson et al., 1997). Hence, the low frequency part of the HRV spectrum is not a pure index of sympathetic influences, which is a drawback of the Fast Fourier transformation procedure and has implications for further interpretation of HRV data. However, it is common practice to report the low frequency HRV to high frequency HRV ratio to represent strength of cardiac sympathetic HR modulation (Montano et al., 2009; Spaak et al., 2010).

In contrast to low frequency HRV, the mechanism of very low frequency (VLF) HRV is not fully understood. VLF has been said by some to reflect mainly sympathetic system activity, but others think that the VLF fluctuations may be caused by mixed SNS and PNS (sympathovagal) mechanisms (Mamiy, 2006).

The ability to engage PNS control of heart beat is regarded as an index of the capacity for self-regulatory effort (Appelhans & Luecken, 2006; Segerstrom & Nes, 2007). Although HRV can be used to compare cohorts at rest, but it is most effective at revealing inter-individual differences when individuals are responding to a specific challenge. For instance, Segerstrom and Nes (2007) used an experimental manipulation of self-regulation and found that HRV was elevated during high self-regulatory effort relative to low effort. Hence, HRV increases in relation to the intensity of self-regulatory effort (Segestrom & Nes, 2007).

There is very little research on how mindfulness modulates the physiological effects of induced stress, though some findings suggest that the mindful state leads to an increase in HRV associated with PNS activity while meditating (Ditto, Eclache, & Goldman, 2006; Lehrer, Sasaki, & Saito, 1999; Takahashi et al., 2005). Some preliminary evidence also suggests that mindfulness is associated with greater PNS involvement during recovery from a stressor. Garland (2011) investigated mindfulness among alcohol-dependent inpatients and found that individuals with higher self-rated mindfulness had less difficulty with resisting the urge to drink and showed greater high frequency HRV recovery following exposure to stress-primed alcohol cues. Kemeny et al. (2012) exposed undergraduate participants to intense 8-week training in mindful and self-regulation techniques, and later assessed them using the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) protocol, which involves developing and performing a speech on a preselected topic as well as doing a mental arithmetic task. Greater reported time spent practicing mindfulness was associated with lower BP and higher respiratory sinus arrhythmia, an index of PNS activation, during the task and during recovery from the task even 5 months after training.

On the other hand, conditions associated with reduced mindfulness have been associated with attenuated parasympathetic HRV activity. Individuals with generalized anxiety disorder (GAD), which is characterized by excessive and uncontrollable worries for more days than not (APA, 2000), are known to show both low levels of self-rated mindfulness (Mankus, Aldao, Kerns, Mayville & Mennin, 2013; Roemer et al. 2009) and low HRV (Thayer, Friedman, & Borkovec, 1996). Individuals with major depressive disorder, who are believed to display higher levels of cardiovascular morbidity and mortality (Murphy, Monson, Olivier, & Leighton, 1987), also tend to show low HRV relative to controls

(Agelink, Boz, Ullrich, & Andrich, 2002; Nahshoni et al., 2004). Studies assessing HRV following mental stress all report increased sympathetic and decreased parasympathetic activity. In fact, emotions associated with life stress, such as anger (McCraty, Atkinson, Tiller, Rein, & Watkins, 1995) and hostility (Sloan et al., 1994) are associated with attenuated HRV.

It is suspected that depressive disorders influence autonomic nervous system (ANS) function in a manner characterized by a reduced parasympathetic and/or increased sympathetic tone (Agelink et al., 2002). It has been suggested that the repetitive activation of negative thinking that individuals with depressive tendencies are known to suffer from exacerbates the physiological arousal that accompanies emotional distress (Teasdale et al., 1999).

Though some studies on mindfulness and reactivity exist, it is difficult to draw systematic conclusions due to great variability in methods, measures, and populations under study. Most of these studies fail to capture participants' mindfulness skills that may be associated with the physiological changes because they do not administer mindfulness self-report measures. To really understand how mindfulness affects the capacity for emotional self-regulation, it is necessary to combine self-report measures with physiological indices of reactivity taken during activities that necessitate self-regulation. It is the aim of the next section to explain how this may be undertaken experimentally.

Using Experimental Tasks to Induce Stress Reactivity and Down-Regulation

An objective of this chapter is to better understand how individual differences in mindfulness influence the ability to regulate emotional responses and coping. One way to approximate this dynamic real-life process of self-regulation in an experimental setting is to observe psychophysiological reactivity in response to a task that challenges the ability to manage attention and inhibit rumination or distraction. Personally-relevant recall tasks, such as anger induction or biographical recall, are considered particularly fitting for the induction of physiological arousal, as opposed to challenge tasks that are not personally meaningful (Velasco & Bond, 1998). For instance, the Social Competence Interview (SCI), elicited reactivity associated with a situation of the experimental participant's choice where an important interpersonal goal was threatened or thwarted. This protocol produced blood pressure reactivity equal to or in excess of that produced by mental arithmetic and a frustrating mirror tracing task (Ewart & Kolodner, 1998). Previous research also shows that the validity of emotional recall tasks is enhanced when data about the participants' emotions and level of experienced emotions, such as anger, anxiety, frustration, and interest, is collected, because distinct emotions are associated differentially with sympathetic and parasympathetic responding (Kop et al., 2011; Marci et al., 2007). In particular, validation of self-reported emotional states is an important part of the assessment of emotional reactivity because the negative emotions experienced during the recall of an experience are associated with central nervous system activity – specifically, increased sympathetic reactivity mediated by the vagus nerve.

As previously mentioned, mindfulness is associated with greater emotional self-regulation through down-regulating negative emotionality (Modinos, Ormel, & Aleman, 2010). A greater capacity to be mindful in daily life would be associated with lesser engagement of sympathetic activity during the stress task as well as with the disengagement of sympathetic activity following the task. The capacity to engage parasympathetic (vagal) regulation of heart beat during the recovery following the emotional recall task would be greater among individuals with better developed mindfulness skills. One way to induce recovery is to induce a mindful state in participants through a mindfulness manipulation procedure while measuring physiological processes. It is the aim of the next section to discuss how mindful responding might work during the recovery phase following an emotional task.

Manipulation of Mindfulness and Support for Benefits of Mindfulness Training

Mindfulness training provides individuals with a set of skills for being aware of their emotional states without feeling overwhelmed by them. For the cultivation of focused awareness among novice practitioners, a focus on breathing is a relatively easy “entry point for meditation in general and mindfulness training specifically” (Feldman, Greeson, & Senville, 2010, p. 1003). In fact, inducing a mindful stance through the practice of anchoring attention to the breath has been the focus of some recent research. For example, studies have induced a self-focus by presenting participants with mindfulness-consistent statements (Sauer & Baer, 2011), had them practice a guided meditation with instructions to think about the sensations of their own breathing (Burg & Michalak, 2012), and provided guided meditations focused on sustained attention and breath control (Feldman, Greeson, & Senville, 2010; Kubota et al., 2011). These exploratory studies have included a small number of participants, but all support the hypothesis that taking part in such activity even briefly results in a desirable behavioural change, such as improved distress tolerance in the face of a distressing task (Sauer & Baer, 2011) or enhanced self-ratings of dispositional mindfulness (Burg & Michalak, 2011) or state mindfulness (Feldman et al., 2010).

What is necessary also in understanding the underpinnings of mindful awareness, and what these studies still generally lack, is a validation that there is an actual change in the experience of mindfulness. Specifically, it is not clear that the changes in self-report reflect anything more than a change in the awareness of a desired reporting pattern. Thus, comparisons of self-report state measures in parallel with physiological measures of parasympathetic and sympathetic control will provide better evidence for the validity of mindfulness training, as the next section will explain. An appropriate state measure is one that Lau and colleagues developed in a 2006 study. This measure, the Toronto Mindfulness Scale (TMS), is designed to be administered immediately following mindfulness practice. It contains a scale called "decentering," which reflects "a shift from identifying personally with thoughts and feelings to relating to experiences as mental events in a wider context or field of awareness" one's experience in a wider field of awareness" (Teasdale et al., 2002, p. 276). In other words, decentering involves viewing one's internal experience with increased objectivity (Feldman, Greeson, & Senville, 2010). The TMS may represent a more ecologically valid assessment of the mindful experience because it asks participants to rate their mindful skills immediately following a mindfulness session. Self-ratings of mindfulness can potentially be combined with methods of physiological reactivity, which will be outlined in the subsequent section.

Blood Pressure

A number of methods of measuring arterial BP exist. The intra-arterial catheter method, which is the most direct, requires invasive procedures and carries the risk of side effects like arterial damage and infection (Perloff et al., 1993). In consequence, a number of indirect methods have come into use, including auscultatory sphygmomanometry, oscillometry and arterial tonometry (Pickering et al., 2005). Auscultatory sphygmomanometry was for a long time the gold standard method of measuring arterial BP indirectly (Pickering et al. 2005). It involves placing a cuff around the upper arm and inflating it to above SBP, then detecting the resulting pulse sounds with a stethoscope. This technique is limited in its accuracy and tends to yield SBP values that are lower than true ABP and DBP values that are too high (Pickering et al., 2005). Arterial tonometry, which has been developed for measurement of BP from the radial artery, is not recommended for routine clinical use due to cumbersome calibration, difficulty positioning the sensor, and scatter between estimated and true values (Pickering et al., 2005). Finally, the oscillometric technique is dependent on recording oscillations in pressure from a sphygmomanometer cuff as it gradually deflates (Mauck, Smith, Geddes, & Bourland, 1980). Although this method only employs estimates of SBP and DBP, relative to other indirect methods of arterial BP measurement it is easier to use as it does not require extensive calibrating and repositioning of the transducer and is less susceptible to external noise (Pickering et al., 2005). This technique has been used in ambulatory BP monitors, home monitors, and doctor's offices. Automatic oscillometry can be used at home by the patient and is preferred even in clinics. However, the technique's accuracy is low and errors of 10–15 mmHg are common (Nitzan, Slotki & Shavit, 2017).

Although HR and BP are valid measures of sympathetic reactivity, variability of these indices does not present the full picture of SNS and PNS interplay. For a better understanding of self-regulatory changes in response to a psychosocial stressor, heart rate variability methods are indicated, and will be explained in the next section.

Heart Rate Variability

A variety of methods of representing HRV in short term recordings exist. The recommended methods of representing variations in heart rate that have been applied in studies on physiological and emotional reactivity include frequency and time domain methods and time domain methods (Task Force of the European Society of Cardiology, 1996; Hypertension Canada, 2017)).

Frequency domain methods. The most common algorithms used to estimate the various contributions of sympathetic and parasympathetic activity include Fast Fourier transformation (FFT), autoregressive analysis (AR) and coarse-grain spectral analysis (CGSA). As a method of estimating spectral density, Fast Fourier Transformation (FFT) a non-parametric method which has the advantages of high processing speed and simplicity of the algorithm employed (Task Force, 1996). FFT analysis is very popular in the scientific community because it is simple to apply, provides a good graphical representation of the R-R signal, and is easy to apply by computer (Aubert, Seps, & Beckers, 2003). In FFT, the R-R signal is not filtered prior to processing, which ensures that none of the information is lost. FFT decomposes the R-R signal into seven partially overlapping but equal components, which then allows plotting the power of each such component as a function of its frequency (Aubert et al., 2003). However, because the signal is not filtered, it is often accompanied by spectral noise which must be eliminated to provide a more accurate analysis. To eliminate this noise, parameters must be applied to provide a more accurate analysis, but these parameters are estimated and imperfect, and may result in a failure to represent the signal accurately (Harris, 1978). This results in limited frequency resolution, which is directly related to the duration of the recording period (Aubert, Ramaekers, & Aubert, 1999).

In contrast, AR is a parametric method. While it yields improved resolution or the signal and smoother representation of spectral components as opposed to FFT, a limitation of AR is that the researcher is required to choose a suitable parametric model a priori and then verify that it provides a suitable fit for the data being processed (Task Force, 1996). If the model is not chosen correctly, it may negatively affect the determination of the time series and the power spectra (Aubert et al., 2003).

The third algorithm commonly used to analyze the R-R signal is CGSA, a method which relies on quantifying the harmonic LF (<0.15 Hz) and HF (0.15 – 0.40 Hz) components from the non-harmonic (noise) components of heart rate variability (HRV), which occur in the very low frequency range (0.00003 – 0.1 Hz) (Yamamoto & Hughson, 1991). This method clearly identifies HF and LF components of the HRV spectrum, and is particularly well-suited for participants who suffer from heart failure or hypertension and who are characterized by depressed HRV and attenuated parasympathetic reactivity, which may make various components of the R-R signal more difficult to observe (Notarius et al. 1999; Yamamoto & Hughson, 1991). But this method does not yield as appealing a graphic representation as FFT. For a population of young adults with no known pre-existing cardiovascular disease, FFT is deemed a preferable method. In addition to FFT, many researchers use time domain methods of HRV analysis.

Time domain methods. Time domain measures are perhaps the simplest way to represent variations in heart rate (Task Force, 1996; Kleiger, Stein & Bigger, 2005). These methods consist of various statistical representations of the NN intervals, or intervals between heart beats. These methods can be used to analyze 24 hour recordings but can also be applied for shorter segments of recording period. They are recommended for comparison of HRV to be made during different activities, such as resting and reactivity to a task (Task Force, 1996; Kleiger, Stein & Bigger, 2005). For this reason, these methods are preferable for use in experimental protocols that compare baseline periods to tasks.

Summary

Mindfulness self-report data combined with concurrent measurements of physiological responding could provide valuable insight into the mechanics of mindfulness practice and whether it produces changes in attentional and emotional regulation. Such knowledge is lacking in outcome studies of mindfulness training, which tend to track reduction in depression and anxiety symptoms following the training program, but often fail to compare these clinical changes to mindfulness self-ratings. Findings that link state mindfulness with state physiological reactivity would provide biometric support for the benefits of mindfulness training, and may help identify which mindful characteristics are most closely associated with health benefits. In addition, the study protocol may raise awareness of the benefits of mindfulness among those participants. They may be encouraged to develop mindfulness as a practical skill in daily life, whether it be by practicing mindful breathing before a test or by using it to return to baseline following a stressful event.

The Proposed Study

Mindfulness is typically described as a dynamic state supported by a specific set of skills. Despite this, mindfulness has been examined in the empirical literature primarily as a trait. The psychometric difficulties and biases associated with this practice have been well documented. Nonetheless, few studies have made attempts to validate the construct of self-rated mindfulness by using external referent measures such as psychophysiological measures, and almost none have used a personally relevant task to elicit physiological activation and self-regulation. The current study extends previous mindfulness and psychophysiology research by examining the relations among self-report measures of mindfulness, state self-report measures of mindfulness, and sympathetic and parasympathetic responding across a range of self-regulatory conditions, including an induced emotional recall task as well as a mindfulness manipulation task.

The induction of mindfulness is an important task in this study because it is intended to demonstrate how improving awareness of the present moment affects physiological and emotional self-regulation. Though a sizeable literature exists to support the benefits of mindfulness training, change in mindfulness, with its predictors and benefits, is rarely emphasized in research designs. Some studies have examined the induction of mindfulness among novice practitioners or studied the attentional concomitants of the tendency towards mindfulness among meditation-naïve individuals, but such studies typically use small samples and lack multiple measures of constructs that are not psychometrically well-defined. Such knowledge is important because decentering is emphasized as not some abstract idea or static trait, but a practical skill highly applicable in daily life. It is the aim of the current study to provide support for the benefits of mindfulness while providing evidence for the concurrent validity of self-reports of mindfulness. With this intent, the study seeks to answer the following research questions: (1) Will mindful individuals, who demonstrate a high level of mindful traits based on self-report, also show better parasympathetic control during baseline and the three self-regulatory phases (calming phase, mindful breathing exercise, and recovery phase; Figure 1)? (2) Will participants with higher self-rated mindfulness show lower sympathetic activation during the emotional stress task and lower sympathetic activation during the self-regulatory stages? (3) Will higher decentering ratings on the TMS scale coincide with higher parasympathetic reactivity during the recovery baseline?

Research Hypotheses

The current study proposed a parsimonious model with specific predictions.

Hypothesis 1. *Validating the task.* The autobiographical recall interview task was intended to capture an individual's heightened physiological and emotional reactivity while recalling a recurrent real-life problem. The task was expected to induce a change in physiological activity, reflected in increased sympathetic arousal during the emotional recall task relative to the pre-interview period, when participants are expected to be at their baseline level and relatively unperturbed. Greater sympathetic arousal was expected to be reflected in higher systolic BP, diastolic BP, HR and skin conductance response. Previous research has documented that certain types of autobiographical recall tasks can induce changes in sympathetic activity. For instance, personally relevant tasks such as happiness recall have been shown to produce increases in low-frequency HRV among 20 healthy young adults with no previous history of medical problems affecting the heart and no diagnosed psychiatric problems (Kop et al., 2011), while emotional recall eliciting anxiety has been related to heightened skin conductance level responses among 40 healthy adult volunteers (Velasco & Bond, 1998). Marked changes in level of sympathetic arousal were expected between the participants' emotional recall task and the calming phase immediately following the recall task, and also between the emotional recall and the recovery baseline condition, when participants were expected to have returned to their typical level of arousal when not reacting to external stressors. In sum, pronounced contrasts in sympathetic activity were expected to occur between the baseline immediately preceding the recall task and the task itself, between the recall task and the calming phase that immediately follows, and also between the recall task and the recovery baseline condition. It was also expected that a higher degree of engagement with the task would be associated with greater physiological responsivity to the task.

Hypothesis 2. *Relations between measures of mindfulness and physiological reactivity*. It was expected that participants who view themselves as having high awareness of the thoughts, emotions, activities and sensations that they experience moment-to-moment, without the need to react to and judge these experiences, would also show greater parasympathetic modulation of HR, which is considered an index of healthy emotional and behavioural self-regulation. Specifically, it was expected that individuals who score higher on the MAAS as well as on the five subscales of the FFMQ, including observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience, would show greater parasympathetic modulation of the heart at rest, during the calming phase immediately following the emotional recall task, during the mindful-breathing exercise, and during the subsequent recovery baseline, which is meant to capture participants' typical level of reactivity when not responding to external stress.

It was also expected that participants who view themselves as more mindful in daily life would react less dramatically and more adaptively when recalling a recurrent experience of stress, consistent with their lower tendency to judge and ruminate upon their experience. Specifically, they were expected to show less dramatic activation of the metabolically costly sympathetic autonomic activity, or lower mobilization of the fight-or-flight response during the stress task. Accordingly, it was expected that high self-ratings of mindfulness would be negatively related to SBP and DBP, HR and skin conductance increases during the autobiographical stress task. It was also expected that mindfulness would be negatively related to SBP, DBP, HR, and skin conductance during the recovery phase, because mindful individuals should be quicker to return to baseline.

It was also expected that individuals scoring highly on the decentering subscale of the Toronto Mindfulness Scale following a short mindfulness manipulation exercise (designed to induce a temporary state of simply being present with one's emotions and sensations without reacting to them) would show more effective down-regulation of physiological reactivity following the emotional recall task, as reflected by stronger parasympathetic regulation of heart beat during the calming phase, the mindful breathing manipulation, and the recovery phase. Individuals who respond well to the mindfulness manipulation were also expected to show lower sympathetic activation reflected in low frequency HRV in normalized (NU) units as well as stronger high frequency HRV (NU), lower low frequency HRV to high frequency HRV ratio, which is an additional measure of sympathetic cardiac functioning. I addition, they were expected to show lower skin conductance response, and lower HR and SBP and DBP during these phases.

Methods

Power Analysis

To determine the number of participants needed for hypothesis I, pilot data from 47 undergraduate participants were used to run within-subjects contrasts with skin conductance and ratio of low-frequency to high-frequency HRV as outcome variables. Large effect sizes were obtained. An *a priori* power analysis using G*Power v. 3.1.5. (Erdfelder, Faul, & Buchner, 2007) was conducted to determine the number of participants required to meet the assumption of adequate sample size, and a sample size of eight was suggested. To determine the number of participants for hypothesis II, pilot data were used to compute correlations on the association of mindfulness and physiological variables, yielding medium effect sizes. An *a priori power* analysis was carried out assuming a medium effect size, and a sample size of 50 was suggested.

Participants

Following power analyses and anticipated lost data due to technological issues (approximately 10%), 55 University of Windsor undergraduate student participants were recruited through the University of Windsor undergraduate psychology participant pool, in order to make allowance for cases that might need to be eliminated during data cleaning. The mean age of the sample was 22.67 years (SD = 5.82). The majority of participants were women (72.2%). Participants were 44.4% Caucasian, 16.7 % Asian or Asian descent, 11.1% Black, 22.2% Other/Mixed, and 5.6% of participants preferred not to answer. Students with a history of allergies to medical equipment (e.g., latex allergy) and with current cardiovascular and respiratory disease were excluded through the screening criteria. There were no other exclusionary criteria. Individuals with baseline blood pressures (BP) in the hypertensive range, or those who had a resting systolic BP at or above 140 mmHg, or a resting diastolic BP at or above 90 mmHG, were expected to be treated separately in the statistical analyses. No such participants were identified, and therefore none were eliminated. Since the beginning of this study, new criteria for hypertension have been adopted, which specify resting systolic BP of 120 mmHg or above and resting diastolic BP of 80 mmHg or above as the hypertensive level (Hypertension Canada, 2017). Under the new criteria, 5 out of 54 participants would have been classified as hypertensive.

Measures

A *Demographic and Health Questionnaire* was used to collect data about the participants' physical and mental health history as well as any recent caffeine use, exercise, and recent experiences that may have had an influence on the participants' emotional state. These variables, meant to be correlated with study variables and potentially used as control variables, are listed in Table 2.

Mindfulness measures. *The Five Facet Mindfulness Questionnaire* (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) is a five-factor self-report assessment measure created following an exploratory factor analysis, which used a combined item pool from five questionnaires measuring mindfulness as a trait or tendency in daily life (see Appendix B). The FFMQ was designed for use among populations with little to no mindfulness experience and has 39 items. Items are rated on a Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). These items form five factors representing distinct but related dimensions: observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. All five factors show adequate to good internal consistency (Cronbach's alpha coefficients = 0.75 - .91). The FFMQ has shown significant relationships in the predicted directions with a variety of constructs related to mindfulness (Baer et al. 2006). The Describe scale has been found to positively correlate with emotional intelligence ($r(300) = .60$, $p<0.001$) and negatively with alexithymia ($r(300) = -.68$, $p<0.001$. The Observe scale was positively correlated with openness-to-experience ($r(300)= .42$, $p<0.001$). The Non-React subscale was positively correlated with self-compassion ($r(300)=.53$, $p<0.001$). In addition, all factors except Observe yielded moderate negative correlations with maladaptive psychological symptoms (Baer et al., 2006).

The *Mindfulness Practice - History Questionnaire* (Baer, Smith, & Allen, 2004). Participants were asked to complete a short questionnaire assessing any previous experience with meditation and other contemplative practices. This six-item questionnaire asks participants to rate the length of time for which they may have been involved with each practice (see Appendix C).

The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) is a 15-item measure of individual differences in the frequency of mindful states over time, using a 6-point Likert scale from 1 (almost always) to 6 (almost never;see Appendix D). High scores reflect better-developed mindfulness skills. The items tap into cognitive, emotional, sensory, and interpersonal domains. It is a single factor scale with strong internal consistency, indicated by a Cronbach alpha of .82 for the student sample of 60 and .87 for a general adult sample of 239 (Brown & Ryan, 2003). The MAAS was correlated with several sub-scales of the Trait Meta-Mood Scale, including clarity of emotional states ($r(313) = .49$; $p<.001$), mood repair ($r(313) = .37$; $p<.001$) and attention to emotions ($r(313) = .19$; $p< .001$). The MAAS also showed a small positive correlation with the NEO-PI openness-to-experience ($r(313) =.18$; $p<.01$), and a moderate negative correlation with self-reported social anxiety ($r=-.36$; $p<.001$).

Mindfulness manipulation. The *Mindful Breathing Exercise* (MBE; Burg & Michalak, 2011) is a 12 -minute task administered by audiofile using an MP3 player (see Appendix E). Participants followed along with a series of verbal instructions (guided meditation) directing them to focus on their breathing. This exercise was developed as a strategy for mindfulness induction (Burg, Wolf, & Michalak, 2012). Participants began by reading instructions which introduce the concepts of mindfulness and meditation (e.g., being mindful in the present to appreciate life instead of getting lost in thinking about the past or the future, returning to one's breath in an accepting and patient manner during the exercise). That was followed by a short exercise to teach participants how to focus on their breathing. Participants were instructed to take five breaths and to determine where they perceived and sensed their breath within their body (e.g., in the abdomen, chest, or nose). Next, participants were given the opportunity to questions, and then started the audiofile, which began the mindful breathing exercise. The audiofile instructed participants during the experiment: They were asked to "observe and sense" their breathing while in a seated position with eyes closed or directed at an arbitrary point in the lower visual field. When they noticed that their mind had wandered, participants were guided to return their focus to their breathing without harshly judging their distractibility. At random times during the recording, participants would hear instructions reminding them to non-judgmentally return their attention to the breath. The 12-minute task was used during the first session of testing. Tasks of this length have successfully been used in protocols of short-term mindfulness induction (Sauer & Baer, 2011; Rausch, Gramling, & Auerbach, 2006). Previous research also shows that short-term mindfulness induction of a few minutes can result in more adaptive autonomic functioning during or directly following the induction (Kubota et al., 2001; Telles, Naveen, & Mohapatra, 2005). During the second session, a 7-minute version of the task was used, for the purposes of physiological data collection.

The *Toronto Mindfulness Scale* (TMS; Lau et al., 2006) was designed to be administered directly after a person meditates and includes 35 items. Participants were asked to respond to items about their experiences while meditating. There are two scales: Curiosity and Decentering. Decentering consists of seven items emphasizing the participant's ability to de-identify from his or her thoughts and feelings (e.g., “I experienced my thoughts more as events in my mind than as a necessarily accurate reflection of the way things really are.”) and the ability to observe thoughts and feelings without analyzing or attempting to alter them (“I was more concerned with being open to my experiences than controlling or changing them”) (see Appendix F). It has been previously used with meditation-naïve participants immediately following a meditation session. Directly after the exercise, participants completed the TMS based on what they were aware of experiencing during that period. The scale showed a high internal consistency (Cronbach alpha = .95). The composite reliability index for *Decentering*, described as analogous to the alpha coefficient, was .91. Decentering was moderately positively correlated with reflective self-awareness represented by the Rumination-Reflection Questionnaire (RRQ; Trapnell & Campbell, 1999) ($r(163)= .42$; $p<.001$). It also showed small to moderate positive correlations on two sub-scales of the Tellegen Absorption Scale (TAS; Tellegen & Atkinson, 1974): absorption ($r(163)=.22$, $p<.01$) and psychological mindedness ($r(163)=.23$, $p<.01$), and showed a positive correlation with openness-to-experience ($r(163)=.23$; $p<.01$), which reflects an open attitude towards one’s experience (NEO-FFI; McCrae & Costa, 1985).

Measures during which physiological reactivity (HRV, BP and SCR) will be recorded.

Emotional recall. The *Social Competence Interview* (SCI; Ewart & Kolodner, 1991) is a brief protocol that assesses physiological and social–emotional responses to a recurring real-life problem. It begins with the interviewer ascertaining whether the problem frequently causes stress (see Appendix G). The interviewer then asks why the problem was stressful, how often it occurred, and invites the participant to describe a specific instance when the problem arose: generally, a situation when fulfillment of a valued goal was threatened. The first phase of the SCI is spent reconstructing this situation, with attention to visual detail as well as any social contact or conversations that the participant may have had. The participant's behaviours, verbalizations, and thoughts, what the participant avoided doing or saying, what happened as a result, and how others responded are also discussed. The interviewer neither challenges nor criticizes the participant but tries instead to help the person re-experience the moment using guided imagery, empathic remarks, and reflective listening (Ewart & Kolodner, 1991). A standard set of probes are used, which resemble the typical questions used to re-construct a problem situation and elicit the participant's thoughts, feelings, physiological reactions, and behavioural responses during cognitive-behavioural therapy (Beck, 2011).

The SCI was developed with the intent of creating an ecologically valid measure for the assessment of socio-emotional regulatory mechanisms believed to influence exposure to chronic, health-damaging stress. It has previously been used in tandem with measures of cardiovascular response, hormones, and other indices of physiological reactivity in response to inter-personal stress (Ewart, Jorgensen, & Kolodner, 1998; Ewart, Jorgensen, Schroder, Suchday, & Sherwood, 2002; Ewart & Kolodner, 1991). Specifically, a 14-minute version of the interview elicited a larger blood pressure response among adolescent participants than was elicited by video game, MT, or mental arithmetic stressors (Ewart & Kolodner, 1991). The SCI has shown good psychometric properties when administered to adolescent samples. It demonstrated test-retest reliability of SBP over a six-month period (r=.74; p<.001), for DBP (r=.54, p<.001) and HR (r=50, p<.001), which was at least comparable to other cognitive stress tasks examined (Ewart & Kolodner, 1991). The SCI has demonstrated good internal consistency, validity, and temporal stability over a 3-month period, provoking stress responses comparable to, or at higher levels than tasks such as mental arithmetic or mirror tracing,and showing stronger associations to ambulatory blood pressure than those stressor tasks (Ewart et al., 2002). It has been used to elicit physiological responding with adolescents (Ewart & Kolodner, 1991) as well as young adults (Cribbet, Williams, Gunn, & Rau, 2011).

Validation of emotional response to the SCI. This short measure was administered directly following the SCI to validate the emotional responses experienced by the participants during the emotional recall task (see Appendix H). Participants were instructed that the exercise was for the purpose of rating their engagement with the task, and were asked to rate on a scale of 1 to 10 to what degree they experienced anxiety, anger, frustration, interest, and control of emotional responding during the SCI. These questions were administered verbally by the interviewer and responses were recorded by the interviewer, because participants were hooked up to physiological equipment, making writing difficult. This protocol is often used by researchers employing emotional recall tasks because specific emotions are associated with parasympathetic and sympathetic physiological reactivity (Kop et al., 2011).

The calming phase. For two minutes, the participant was asked to talk about what they like to do during their spare time or to discuss their plans for the summer or winter break. Physiological data were continuously collected at this stage in the procedure, and were screened on a computer by the technician. The purpose of this distractor is to reduce participants' emotional arousal following the SCI. Self-distraction is a method of self-regulation and a coping skill, and provides information about the participants' ability to self-regulate directly following a stressful event. The distractor also helped them return to physiological baseline before the start of the mindfulness exercise. When very upset, it is often preferable to self-regulate through distraction rather than directly engage in a contemplative task like mindful breathing (Batchelor, 2011).

Heart rate variability measurement during mindfulness manipulation. A short 7-minute version of the Mindful Breathing Exercise (MBE), with identical instructions as the 12-minute version, was used. This version is specifically designed for measurement of heart rate variability during mindful breathing (Burg, Wolf, & Michalak, 2012). Participants who were more able to mindfully stay in contact with their breath during the full version of the MBE displayed higher parasympathetic HRV during a 5-minute segment of the exercise that was analyzed (Burget al., 2012).

Physiological measures.

Two types of peripheral nervous system measures were collected: Those associated with changes in sympathetic reactivity, including SBP and DBP, HR, and skin conductance reactivity (SCR), and those reflecting changes in parasympathetic reactivity, which specifically refers to heart rate variability (HRV).

All physiological measures were collected continuously during two initial baselines, the emotional recall Social Competence Interview (SCI), the Mindful Breathing Exercise (MBE), and the post or recovery baseline.

Blood Pressure (BP) and Heart Rate (HR). Resting BP was measured in the participants' left arm using non-invasive automated brachial oscillometry (Dinamap Carescape v100, Critikon). This was done regardless of whether participants were dominant right or left-handed, in accordance with procedure previously outlined in past research (Ewart & Jorgensen, 2004). Dinamap readings have been found to approximate very closely the readings obtained by simultaneous intra-arterial recording, with between-method correlation coefficients of 0.98 and 0.97 for SBP and DBP, respectively (Borow & Newburger, 1982). Pulse rate is obtained from the brachial artery during cuff deflation condition. The cardiovascular measures include systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR). For the purposes of the current study, SBP, DBP, and HR were the focus.

Following 10 minutes of seated rest, during which participants habituated to the experimental environment while viewing a neutral stimulus on a computer screen, consistent with recommendations on participant preparation (Pickering et al., 2005), SBP, DBP and HR were gathered. Participants sat while resting their left arm at heart level, and the BP cuff was placed approximately 2.5 cm proximal to the antecubital fossa (Pickering et al., 2005). Typically, HRV data are recorded in a supine position (McGowan et al., 2013; Notarius & Floras, 2001; Young & Leicht, 2011). In fact, when Young and Leicht (2011) examined the effect of participants' position on resting HRV recordings lasting 10 minutes, they found that heart rate was greater and low frequency as well as high frequency HRV measures were lower in the supine rest as opposed to seated rest. In the current protocol, participants were recorded in a seated position because of the need to face the table for experimental stimuli and to face the interviewer during the interview task. It is noted that this modification may have affected physiological findings by lowering HR and raising LF and HF HRV power.

During the 10-minute baseline, and the 10-minute recovery phase, BP and HR were measured every two minutes by an electronic blood pressure monitoring device (Dinamap Carescape v100, Critikon (Critikon, Tampa, FL) for a total of 5 readings during the baseline and 5 readings during the recovery phase, of which the first reading was discarded and the last 4 used for overall averages of BP and HR (see Appendix I). The BP monitor was turned off during the SCI, except for one single measurement of DBP, SBP and HR which will be taken at the end of the SCI to record the participants' level of arousal directly following the challenging part of the task.

Electrocardiogram (ECG). ECG data was used to derive HRV data, and was detected at a sampling frequency of 1000 Hz using PowerLab hardware (AdInstruments, Colorado Springs, Co), in compliance with the recommendations of Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996). First, two disposable Ag-AgCl electrodes were attached just under the participants' right and left clavicles, with a ground electrode attached to the right waist, according to a procedure previously used in cardiovascular reactivity research (McGowan et al. 2009). Using LabChart 8 software (AdInstruments, Colorado Springs, Co), the ECG signal was transformed into a series of interbeat intervals (IBIs). In HRV analysis, interbeat intervals (IBIs) are defined as the temporal distance between R-spikes, the waveform that corresponds to the contraction of the ventricles of the heart (Appelhans & Luecken, 2006).

Nonetheless, measurement of changes in HRV is not a specific enough index of self-regulatory ability, because it is a combined index of sympathetic and parasympathetic reactivity. An increase in HR reflected in shorter beat to beat intervals could arise from either increased sympathetic activity or decreased parasympathetic inhibition (vagal withdrawal; Thayer & Lane, 2000). To differentiate between these processes, the present study utilized both frequency domain as well as time domain methods to derive HRV components from the raw IBI data, which reflects beat to beat variations in HR (Appelhans & Luecken, 2006).

Frequency domain methods refer to power spectral density (PSD) methods which provide basic information on how power (i.e. variance of IBI data, or variability in distances between successive heart beats) distributes as a function of frequency. Since various frequency bands are differentially associated with the physiological processes or sympathetic and parasympathetic reactivity, this method can provide a record of a person's ANS functioning at a given moment.

Frequency domain HRV analysis.

Analysis of the heart rate power spectrum is a non-invasive set of techniques that came into usage as researchers recognized its utility in parsing out the contribution of the sympathetic and parasympathetic systems in the modulation of heart rate (i.e. Akselrod, 1981; Hyndman & Kitney, 1972). Spectral analysis involves the decomposition of any "steady, stationary, fluctuating time-dependent signal into its sinusoidal components. It allows plotting the power of each such component as a function of its frequency and the computation of the power in defined frequency regions." (Akselrod, 1981, p. 21). FFT is generally used to distinguish three main spectral components, including the non-harmonic very low frequency band (VLF) and the harmonic components of low frequency (LF) and high frequency (HF), which all add up to Total Power, or TP. While the HF component is viewed as a standard measure of parasympathetic influences on the heart, LF reflects both sympathetic activity and activity of the parasympathetic system (Pomeranz, B., Macaulay, R.J.B., & Caudill, 1985). The composition of the VLF component is much less clear and it is very difficult to attribute a specific physiological process to these heart period changes. Moreover, VLF does not have consistent properties and is believed to correspond to non-harmonic noise within the spectrum. Therefore, VLF is not viewed as a valid measure of physiological processes and should be avoided when interpreting the power spectrum (Task Force, 1996).

For the purposes of the present research, the HRV data were derived from the IBI data by applying FFT. The transformation was used to extract Total Power (0 to 0.4 Hz);the high frequency heart rate variability (HFHRV), defined as the respiratory frequency band (0.15 – 0.40 Hz); and the low frequency heart rate variability (LFHRV), defined as the respiratory frequency band (0.05-0.15 Hz) using Kubios 2.2 (Biosignal Analysis and Medical Imaging Group, University of Eastern Finland). The LFHRV , HFHRV, and total power components were measured in absolute values of power (ms^2). The ratio of LFHRV to HFHRV, which reflects sympathetic modulation of HR, as well as the ratio of HFHRV to Total Power, which predominantly reflects the parasympathetic modulation of HR (Task Force, 1996; Spaak et al., 2010), were also calculated. The cumulative average of these HRV indices was calculated from ECG data collected from the initial baseline, the Social Competence Interview (SCI), the Mindful Breathing Exercise (MBE), and the recovery phase.

In addition to the frequency domain method of FFT, HRV time-domain analysis methods appropriate to brief recordings were calculated. Time domain methods represent a simple set of statistical indices which examine variations in heart rate. Either the HR or the intervals between successive heart beats are determined (Task Force, 1996). These include three statistical representations of high-frequency (HF) HR modulation, which predominantly reflects parasympathetic control of heart beat (Task Force, 1996): the standard deviation of the NN intervals (“normal-to-normal”, representing intervals between R waves based on depolarization of the sinus node) (SDNN), the square root of the mean squared differences of successive NN intervals (RMSSD), and the number of interval differences of successive NN intervals greater than 50 ms divided by the total number of NN intervals (pNN50) (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). All these measures were derived from the IBI data using Kubios 2.2 (Biosignal Analysis and Medical Imaging Group, University of Eastern Finland). These three time-domain measures have previously been used to derive HRV in short-term data recordings (Burg, Wolf, & Michalak, 2012; Spaak et al., 2010). The cumulative average of these indices was calculated from ECG data collected from the initial baseline, the SCI, the MBE, and the recovery phase.

Skin Conductance Response (SCR). The skin conductance response (SCR), also referred to as the galvanic skin response, provides a phasic, moment-by-moment measure of sympathetic arousal. It reflects the orienting response, or the general arousal state that follows an unexpected stimulus (Boucsein, 1992). This measure is typically used in research on emotional responding. For instance, it has been applied as an index of sympathetic arousal during and following recovery during stress tasks, such as emotional induction tasks (Boucsein, 2012). There are two types of orienting responses: specific (induced in response to a specific stimulus), and non-specific (occurring in response to internal, mental events) (Boucsein, 2012). Non-specific skin conductance responses, which index skin conductance activity over time, have been previously used to record reactivity during and after a meditation task (Austin, 2006). For the current study, non-specific SCRs were recorded by using galvanic skin response finger electrodes with two stainless steel finger plates designed to be attached to the participant's index and ring finger with Velcro straps (which is attached to a Bio Amplifier; AdInstruments, Colorado Springs, Co). The skin conductance signal is recorded as a waveform, and a change in amplitude from peak to trough is used to derive the SCR. For the purposes of the current study, an SCR was defined as a peak to trough increase of at least 0.05 microsiemens, which is compliant with recent publication recommendations (Boucsein, 2012). The cumulative amplitude of skin conductance responses (SCR) were calculated and divided by the number of minutes for all participants during the initial baseline, the SCI, the MBE, and the recovery baseline.

Breathing rate. The respiratory belt (AdInstruments, Colorado Springs, Co), a piece of material containing a piezo-electric sensor designed to register the participant's respiration, was placed around the participant's abdomen. Data were recorded in the form of a waveform, which appears as a series of peaks and troughs corresponding to the participants' in-breaths and out-breaths. Abdominal respiratory rate was recorded as an additional measure of autonomic system activity, and was used as a reference to compare to the GSR and HR data obtained. Following data collection, the respiratory record was qualitatively reviewed for each participant to determine whether large changes in GSR and HR were due to movement or irregularities in breathing.

Procedure

Familiarization Session (4 participants at a time)

Consent, DHQ, (FFMQ & MAAS/MH in randomized order; ACSS and CASES in randomized order)	Presentation of physiological equipment	MBE	TMS (Decentering scale)
25min	10min	12min	15min

Experimental Session (1 participant at a time; takes place approximately two weeks after the Familiarization session)

Consent, DHQ; Participants asked to wash hands	Physiological equipment setup followed by 10 minutes of stabilization rest	Baseline (Data: breathing, BP, HR, ECG & SCR)	SCI (Data: breathing, HR, SCR, ECG, a single BP measurement at the end).	Calming Phase (Data: breathing, HR, SCR, ECG)	MBE (Data: breathing, HR, ECG & SCR)	Recovery Phase (Data: breathing, BP, HR, ECG & SCR)	Equipment unhooked; RRQ R scale and AF and Coding
10 min	15min/10min	10min	15min	2 min	7min	10min	20min

Figure 1. Schematic representation of study design and timeline. DHQ = demographic and health questionnaire; FFMQ= Five Factor Mindfulness Questionnaires; MAAS/MH= Mindful Attention and Awareness Scale/Mindfulness History; ACSS = Academic Coping Strategies Scale; CASES = College Academic Self-Efficacy Scale; MBE = Mindful Breathing Exercise; TMS = Toronto Mindfulness Scale; BP = Blood Pressure; HR = Heart Rate; ECG = Electrocardiogram; SCR = Skin Conductance Response; SCI = Social Competence Interview; RRQ = Rumination Reflection Questionnaire; AF = Animal Fluency.

Data collection took place over two sessions, in a comfortable, quiet laboratory room. During the initial familiarization session, participants took part in a short presentation about the physiological equipment in order to address any apprehension about the protocol and to inform participants about the procedures before they signed the informed consent form. These sessions were carried out in groups of up to four participants. Following the informed consent, participants completed the Demographic and Health Questionnaire and the self-report dispositional mindfulness measures, including the Mindful Attention and Awareness Scale (MAAS), the Five Factor Mindfulness Questionnaire (FFMQ), and the Mindfulness-History Form, as well as measures of academic, psychological and emotional functioning that were not part of the current study. It was important for participants to complete these measures before the Mindful Breathing Exercise (MBE), thereby preventing the MBE and the Toronto Mindfulness Scale (TMS) from affecting the self-reporting of mindfulness.

Following these three questionnaires, participants were instructed that they would be participating in a brief mindfulness exercise. They were given headphones and mp3 players, and were asked to turn away from the table, face the wall, and press the button to play the audiofile. The researcher remained in the room to make sure audiofiles played, but faced the computer screen away, sitting with her back to the participants. Following the completion of the exercise, participants filled out the *Decentering* sub-scale of the Toronto Mindfulness Scale. Participants were asked to abstain from caffeine for at least 12 hours prior to the next experimental session.

Within approximately two weeks, participants returned for the second session, which all participants attended individually. After providing informed consent and being asked about caffeine, alcohol consumption, recent exercise, and other control variables (see Table 1) participants were asked to use the restroom in preparation to staying seated for the next hour. When participants returned, they were asked to stand while the researcher placed the respiratory belt transducer on the participant's abdominal area, on top of the participant's clothing, and connected two disposable Ag-AgCl electrodes just under the participants' right and left clavicles, with a reference electrode attached to the right waist, according to a procedure previously used in cardiovascular reactivity research (McGowan et al., 2009). It was not necessary for the participant to undress for this part of the protocol. According to communication with Dr. Cheri McGowan of the Department of Kinesiology at the University of Windsor, the chest electrodes are considered the gold standard for the measurement of heart rate reactivity (January, 2014). The researcher then attached the blood pressure cuff on the participant's left arm, 2.5 cm proximal to the antecubital fossa (Pickering et al., 2005). The researcher also placed the finger transducers (for the collection of skin response) on the participant's second and fourth fingers of the left hand.

Subsequently, the participant was seated with feet on the floor and back supported by the back of the chair for 10 minutes of rest for the purpose of physiological stabilization (Pickering et al., 2005). HRV and SCR data from this period were streamed live and observed, but not analyzed. For the duration, the participant was asked to view a slideshow of nature scenes designed to be a neutral stimulus. A 10-minute baseline period followed, during which BP data were collected at 2-minute intervals for a total of five readings. The interviewer recorded the BP data on a worksheet (see Appendix I) and the technician faced the computer to monitor the live data collection.

Following the baselines, the interviewer administered the Social Competence Interview (SCI). For the Calming Phase and the subsequent 7-minute Mindful Breathing Exercise, the participant was asked to remain sitting in the chair and listen to the instructions to pay attention to the breath. Following the MBE, the participant returned to watching the neutral stimulus mentioned above. At the end of this period, the equipment was unhooked. The baseline was followed by the participants' filling out the Toronto Mindfulness Scale (TMS). The participants were also administered two questionnaires which are not part of the current study: The Rumination Reflection Questionnaire (RRQ) and the Animal Fluency and Coding tasks, which were used as an estimate of cognitive functioning.

Results

Data Preparation and Analysis

All study variables were treated as continuous. Data analyses was carried out using the IBM Statistical Package for the Social Sciences (SPSS) (Version 22).

Pre-processing of HRV data. All ECG recordings were manually edited for artifacts and ectopic beats. Only files with less than 5% ectopic beats were considered usable and admitted for analysis, in accordance with the standard procedure (Task Force of the European Society of Cardiology, 1996). Following collection, the data were visually inspected, filtered and edited to exclude any undesirable beats. This resulted in 54 participant files with complete and usable data.

Data pre-processing and reduction. Prior to processing, missing data for all self-report and physiological variables were analyzed and found to be missing randomly using the IBM SPSS 22 missing value analysis (MVA) procedure. Because the analysis revealed less than 5% missing data across all main dependent variables, the SPSS Estimation Maximization procedure was used to fill in missing data.

The indices of BP, or systolic and diastolic BP, as well as HR (pulse) were averaged across baseline and recovery phase. From the baseline and recovery phase, the first reading was discarded and the average of the last four readings was taken. One BP reading was also taken at the end of the SCI protocol and right before the calming phase. A stable estimate of whether BP levels returned to baseline was derived by comparing the last reading (ratio of SBP over DBP) during pre-stress task baseline to the final reading of the post-stressor recovery phase. Based on a paired samples t-test, no difference was found between the last baseline (M=1.72, SD=.22) and last recovery (M=1.70, SD=.19) readings $t(106)=1.12$, p=.27 for 54 participants.

Skin conductance reactivity was recorded as the count of trough-to-peak increases of at least 0.05 micro-siemens. The total count was then divided by the exact number of minutes per block for each participant to ensure standardization between participants.

Cardiovascular and skin conductance-dependent measures other than the initial baseline were derived as change scores. Specifically, stress task reactivity was computed as the difference between the 10-minute baseline and the 15-minute emotional recall task. Post-stressor recoveries were calculated by subtracting the mean reactivity for the period of interest from the mean reactivity during the emotional recall task. The practice of averaging skin conductance response and heart rate variability data per minute is a common one and has been used in previous studies (Jorgensen & Zachariae, 2006; Franz, Schaefer, & Schneider, 2003). Raw change scores rather than residualized change scores were used, as recommended by Llabre, Spitzer, Saab, Ironson, and Schneiderman (1991). To derive heart rate variability measures, ECG recordings for different phases were submitted to HRV analysis. As the emotional recall task tends to vary in length, the last 15 minutes of the recording were used for each participant**.** On average, this task took 15 minutes (*M*=15.23, *SD*=3.20, Range = 8.48 – 22.27 minutes). For a breakdown of all main variables and how they were calculated, see Table 2. For a breakdown of skin conductance response descriptives, see Table 3. For cardiovascular variable descriptives, see Table 4.

Following data reduction involving calculation of change scores, all main variables were checked for normality and influential outliers. Mindfulness state and trait self-report variables were found to be normally distributed. Five individuals with extreme values (those that exceeded a cut-off of 3 standard deviations above the mean) were identified, and in those cases, the extreme numbers were replaced with the next highest value which was not an extreme value. For BP and HR data, three individuals with extreme values were identified, and the extreme numbers were replaced with the next highest value which was not an extreme value.

Once these extreme outliers were replaced, and HRV measures were log transformed, all physiological dependent variables met criteria for normal distribution (fell within +-2 for skewness and +-3 for kurtosis). For descriptives of main variables, see Tables 3 and 4.

Physiological dependent variables were re-examined using the Kolmogorov-Smirnov and Shapiro-Wilk's tests for normality. Skin conductance response and heart rate variability variables which did not meet criteria were subjected to square root transformations and log transformations, respectively.

Main Analyses

Prior to evaluation of the main hypotheses, the effect of control variables on physiological outcome variables during baseline was examined. Control variables included level of mindfulness experience, caffeine use within the last 12 hours, physical activity within the last 24 hours, and when female participants last experienced menstruation. Report of extraordinary stress levels experienced recently was also controlled for, based on participants "yes/no" responses to the question "Have you had any recent experience that has strongly influenced your emotional state beyond the ordinary?" Use of medication potentially affecting BP and/or previous psychiatric diagnosis was reported for only three and four participants respectively, and were not used in analyses.

Based on independent samples *t*-tests, the nine participants who had used caffeine showed greater parasympathetic reactivity during baseline on outcome variables including SDNN (M=71.40, SD = 22.44), as opposed to the 45 participants who had not used caffeine, where SDNN was (M=42.25, SD=18.68), $t(52) = 3.65$, $p < .001$. Cohen's effect size value ($d = 1.41$) suggested a large effect. The nine participants who had used caffeine also showed greater parasympathetic tone during baseline on the outcome variable RMSSD (M=63.49, SD=21.12), as opposed to the remaining 45 participants (M=34.61, SD=18.69), $t(52) = 3.8$, $p < .001$. Cohen's effect size value ($d = 1.45$) suggested a large effect. This group of nine participants also showed greater parasympathetic tone during baseline on the outcome variable pNN50 (M= 40.01, SD=20.68) as opposed to the remaining 45 participants (M=15.53, SD=15.97), $t(52)=2.7$, $p<.001$. Cohen's effect size value ($d = 1.32$) suggested a large effect.

Twelve participants who responded "yes" to the survey question "Have you had any recent experience that has strongly influenced your emotional state beyond the ordinary?" These 12 participants had lower parasympathetic tone during baseline on SDNN (*M*=32.59, *SD*=11.7), $t(52) = 3.8$, as opposed to the other group of 42 participants on SDNN (*M*=51.25, *SD*=22.64). Cohen's effect size value ($d = 1.03$) suggested a large effect. This group of 12 participants also had lower parasympathetic tone on the outcome variable RMSSD (*M* = 26.88, *SD* = 13.75) as opposed to the remaining 42 participants (*M*= 43.00, *SD*=22.47), $t(52)=3.8$. Cohen's effect size value ($d = 0.88$) suggested a large effect. Finally, this group of participants showed lower parasympathetic tone during baseline on the outcome variable pNN50 (*M*= 9.71, *SD*=12.47) as opposed to the remaining 42 participants (*M*=22.44, *SD*=19.70), $t(52)=2.7$. Cohen's effect size value (d = 0.77) suggested a large effect. Continuous measures typically associated with BP, including BMI and age, were correlated with HR, SBP, and DBP to determine if these variables need to be accounted for in analyses. No associations were found.

To evaluate the effectiveness of the emotional recall task in eliciting physiological reactivity during the current study, analyses of planned within contrasts were carried out to test the hypothesis that significant increases in skin conductance response and low frequency heart rate variability (LFHRV) should be observed from baseline through the recall task. There was a significant difference between baseline SCR and SCR during the SCI [$F(1,53) = 116.95$, $p<.001$, $\eta_p^2 = .67$]. A difference was also noted between the stress task SCR and the calming phase SCR [$F(1,53) = 3.97$, $p = .05$, $\eta_p^2 = .07$]. The change between the stress task SCR and SCR during the mindful breathing exercise (MBE) [$F(1,53) = 156.67$, $p < .001$, $\eta_p^2 = .75$] was substantial. Finally, a significant change was noted between the emotional recall task SCR and SCR during the recovery phase [$F(1,53) = 90.92$, $p < .001$, $\eta_p^2 = .63$]. With regard to the BP variables, a significant change in SBP was noted during the stress task, which suggests participants responded to the stress task with an increase in sympathetic reactivity [$F(1,53) = 20.34$, $p<.001$, $\eta_p^2 = .34$].

With regard to the LF to HF ratio, representing the balance between sympathetic and parasympathetic activity, a change was noted between the baseline and the LF to HF ratio during the emotional recall task [$F(1, 53) = 31$, $p<.000$, $\eta_p^2 = .38$], reflecting greater overall low frequency (sympathetic) reactivity during the emotional recall task relative to the baseline. A significant difference between the LF to HF ratio during the emotional recall task and the calming phase [$F(1,53) = 5.1$, $p <.05$, $\eta_p^2 = .09$] was found. A significant difference between the LF to HF ratio during the emotional recall task and the recovery phase [$F(1,53) = 19.76$, $p<.001$, $\eta_p^2 = .27$] was found, reflecting a decrease in the relative contribution of sympathetic reactivity during this phase. No significant difference was found between the LF to HF ratio during the emotional recall task and the mindful breathing exercise. See Figure 1 for a graphical representation of LF to HF ratio across phases.

With regard to LF (NU), representing the ratio of sympathetic activity to the total power of the HRV spectrum, a change was noted between the baseline and the emotional task [$F(1, 53) = 34.56$, $p<.000$, $\eta_p^2 = .40$]. The LF part of the spectrum represents a mix of sympathetic and parasympathetic influences on HR, but LF (NU) is commonly viewed as a rough index of sympathetic reactivity. Hence, these findings are consistent with an increase of sympathetic reactivity during the emotional recall task relative to the baseline. A significant difference between LF (NU) during the emotional recall task and the mindful breathing phase [$F(1,53) = 6.51$, $p <.01$, $\eta_p^2 = .11$] was found. Finally, a significant difference between LF (NU) during emotional recall and the recovery phase [$F(1, 53) = 34.47$, $p<.001$, $\eta_p^2 = .39$] was found. No significant difference was found between the LF (NU) during the emotional recall task and the calming phase.

With regard to HF (NU), also referred to as parasympathetic tone, it represents the ratio of parasympathetic activity to the total power of the HRV spectrum. A change was noted between baseline HF (NU) and emotional task HF [$F(1, 53) = 21.11$, $p<.001$, $\eta_p^2 = .26$], representing a drop in parasympathetic reactivity. A significant difference between HF (NU) during the emotional recall task and the mindful breathing phase [$F(1,53) = 8.44$, $p <.01$, $\eta_p^2 = .14$] was found. Finally, a significant difference between HF (NU) during the emotional recall task and the recovery phase [$F(1,53) = 18.05$, $p <.001$, $\eta_p^2 = .23$] was found. No significant difference was found between the HF (NU) during the emotional recall task and the calming phase. See Figure 2 for a graphical representation of HF (NU) across phases.

With regard to BP change between baseline and the stress task or between the stress task and the recovery phase, non-reactivity to inner experience was moderately negatively associated with increase in SBP during the stress task relative to the baseline phase ($r(53)=.-.28$, $p<.05$). None of the other mindfulness trait variables were associated with BP change between the resting baseline and stress task. Reasons might include the variability in BP change among participants, even after three outliers had been eliminated, as well as low statistical power. See Table 3 for information on range and standard deviation of the BP variables. On average, 54 participants showed a mean increase of 4.54 SBP, but with a standard deviation of 7.19. Participants were separated into cardiovascular responders and non-responders, where responders were defined as those with a change in SBP at or above

4.54. Based on this classification, 28 responders were identified. No associations between trait and state mindfulness variables and SBP or DBP changes during the stress task and recovery were found for this population based on this classification.

As for skin conductance measures, the ability to non-judgementally pay attention to one's experience was positively associated with mean skin conductance reactivity during baseline ($r(53)$=.36, p<0.05), mindful breathing ($r(53)$=.29, p<.05), and recovery ($r(53)$=.36, p<.05).

To examine the hypothesis that participants who achieved high scores on measures of mindfulness would also show greater parasympathetic modulation of heart rate, bivariate correlations were carried out (see Tables 5 and 6). Parasympathetic activation was positively associated with mindfulness during recovery from stress. Specifically, the FFMQ sub-scale describing, or the ability to put one's thoughts, emotions, and other experiences into words, was moderately positively associated with high frequency HRV (NU), or parasympathetic tone, across several experimental phases, including baseline, the mindful breathing task, and the recovery phase (see Table 6). The mindfulness (MAAS) total score was also negatively associated with sympathetic tone during recovery, and the FFMQ subscale describing was negatively associated with sympathetic tone during the mindful breathing task and during the recovery phase. (see Table 5). Contrary to prediction, none of the other mindfulness variables were correlated with HRV.

As predicted, individuals scoring higher on the Toronto Mindfulness Measure (TMS), the state measure of mindfulness filled out following the MBE, showed a larger drop in SCR, an indicator of sympathetic reactivity, between the interview and the recovery phase ($r(53)$=.37, p<.01). The TMS score was also associated with a greater decline in SCR levels between the stress task and the MBE ($r(53)=.37$, $p<.01$). However, TMS scores were also associated with a greater increase in SCR during the stress task. TMS scores were also positively associated with the observing dimension of mindfulness on the FFMQ measure, which measures self-report of the ability to notice one's feelings, thoughts, and sensations as they are experienced.

Discussion

The aim of the current study was to help establish the validity of mindfulness self-report tools. To this end, the study examined whether the quality of mindfulness, captured through self-report measures, would be reflected in resilient psychophysiological self-regulation in response to a challenging, personally-relevant event. Self-ratings of mindfulness were collected and compared to physiological reactions before, during, and after a task when participants spoke about a personally-relevant stressful event. This type of protocol has been used previously as a method analogous to a stressful event occurring in real time (Ewart & Jorgensen, 2004), Physiological data were also collected during a brief mindfulness-induction exercise, when participants practiced focusing their attention on the act of breathing.

The first set of analyses supported the effectiveness of the emotionally-relevant task in eliciting physiological reactivity through comparing sympathetic reactivity before, during and after the stress task. As expected, significant increases in sympathetic reactivity, represented by skin conductance reactivity and systolic blood pressure were observed during the emotional recall task, followed by significant decreases in skin conductance reactivity during the recovery baseline. However, when the proportion of LF heart rate variability to HF reactivity during the emotional recall task was compared to LF to HF ratio during the mindful breathing task, no difference was found. Such a pattern of reactivity fits a curve, where participants exhibit the lowest level of stress associated with the orienting response at the beginning, gradually increase in stress during the stress task, and then gradually decline as the experimental session comes to an end (Figure 2). These findings cast doubt on the effectiveness of the mindful breathing exercise in alleviating sympathetic reactivity following the stress task in a mindfulness-naïve sample. However, in interpreting these findings, it must be considered that the association of LF power and sympathetic functioning is complex. In fact, low frequency fluctuations in HR are affected by electrical stimulation of both vagal and sympathetic cardiac nerves in animals (Parati et al., 2006). Thus, LF components reflect both sympathetic and parasympathetic modulation. Interventions that would be expected to increase cardiac sympathetic activity, such as acute exercise, have in the past not only failed to increase LF power but actually provoked significant reductions in this variable (Houle & Billman, 1999).

Another problem may lie in the experimental design itself. Introducing a mindful breathing exercise shortly after a stress task and a brief calming phase (which was meant to have distracted but may not have alleviated participants' stress level) was not effective in helping participants cope with stress. The unfamiliar context of the exercise - an academic laboratory – may have also played a role. Mindfulness is a personal, individual exercise, and an individual's meditation might be influenced by the presence of others, even though participants had already experienced the meditation during a previous session for practice.

It was also expected that individuals who saw themselves as more mindful, or more aware of their experience in the present moment, would be less likely to experience sympathetic activation during and after the task, which involved the recall of a personally meaningful and emotionally-challenging event. Contrary to what was expected, mindfulness variables were not associated with skin conductance. As for HRV, broadly defined self-reported mindful nonjudgmental awareness was negatively associated with sympathetic reactivity during recovery.

The tendency to describe one's experiences, thoughts, and sensations was associated with increased parasympathetic control at baseline, stress, mindful breathing exercise, and recovery. This finding is important because if those who are able to put emotionally-meaningful experiences into words also show better self-regulation of their emotional experience in response to stress, they are likely more resilient in response to stress.

Some potential explanations exist for why other indices of mindfulness did not show associations with physiological variables. For instance, perhaps the time domain measures used in this study, typically utilized for longer recordings, were not ideal to capture the small moment-by-moment changes elicited during the emotional recall exercise and other tasks. Moreover, it is likely that the effect of error variables, such as caffeine use and stress level prior to the experimental session, affected physiological outcome variables enough to have a confounding effect on the findings. Participants' level of sympathetic and parasympathetic activity during rest and other activities may have also been influenced by situational factors. For instance, 12 participants reported the presence of a heightened emotional state due to some recent event in their lives. Since it is known that negative emotions typical in times of stress are associated with attenuated HRV, often due to heightened sympathetic and lowered parasympathetic functioning, it is likely that participants' stress level prior to the experimental session contributed to restrict HRV and dampened associations between HRV variables and other outcome measures.

In addition, the experimental design may have failed to take into account potential sources of error, such as participants experiencing stress for reasons unrelated to the experimental hypothesis. For instance, it was noted that participants sometimes experienced discomfort due to the placement of the physiological recording equipment, such as the BP cuff.

To better understand whether self-ratings of mindfulness at a state level would be associated with physiological reactivity, associations between a state measure of mindfulness filled out after the mindful breathing task and skin conductance measures were examined. Higher ratings on this state measure were indeed associated with a greater drop in sympathetic reactivity between the stress task and the mindful breathing exercise, which suggests that those who experienced the mindful breathing task more fully or were more focused on it were more likely to experience a reduction in the arousal of the sympathetic, or fight-or-flight response, system during the mindful breathing exercise, even though it was preceded by a particularly stressful, personally-relevant task. These findings are noteworthy because they suggest that individuals aware of their experience in the moment of meditating were less likely to show signs of metabolically costly engagement of the stress response while taking part in the mindful breathing exercise, even though it was preceded by an emotionally challenging task.

Associations between mindfulness and HRV measures across experimental phases were consistent with stronger emotional self-regulation among participants who rated themselves as mindful. Specifically, participants who saw themselves as exhibiting the tendency to stay mindful from moment to moment on the MAAS measure, as well as those who rated themselves highly on the tendency to describe their emotions and states on the

FFMQ measure, were physiologically calmer during and after stress. However, no other subscales of the FFMQ measure yielded an association with physiological variables.

The MAAS is a well-validated measure of the global tendency to be mindful in daily life, which has been previously used in biological research on mindfulness (Brown, Ryan & Creswell, 2007). It is widely used with young adult populations, including university students. It is easily understood and free of jargon (Brown & Ryan, 2003). The FFMQ measure, on the other hand, represents a set of sophisticated mindful skills and places significant demands on the self-rater's ability to self-reflect about oneself. It is also likely that the FFMQ dimensions, such as acting with awareness or non-judgment, were relevant for some participants but not others during this particular experimental task, depending on the stressful situation they chose to discuss. In other words, perhaps these dimensions were too subtle to be reflected in moment-to-moment autonomic changes. The describe dimension of FFMQ, which was associated with physiological reactivity, is an exception. Describe was most relevant to the mindful breathing task, which required participants to be aware of and to describe their feelings and states. That may explain why participants with high self-ratings on the describe dimension also tended to experience lower fight or flight and greater parasympathetic activation during and after the stressful task.

It is also important to address why no associations were found between mindfulness and time domain measures. These measures, which reflect statistical representations of variability in intervals between heartbeats, are typically derived from recordings of about 24 hours in length (Klieger, Stein, & Bigger, 2005). It is possible that the recordings in this study, which were 2 to 15 minutes in length, were too short to properly represent these measures. Moreover, though time domain measures predominantly reflect parasympathetic control of heart beat, they are not a direct measure of parasympathetic modulation. RMSSD is correlated with HF HRV, but it is not the same as the high frequency band of the HRV spectrum (Klieger, Stein & Bigger, 2005). Moreover, it is likely that aspects of the design of the current study, such as small sample size and experimental error affecting vagal reactivity precluded findings for time domain methods from reaching statistical significance.

Another limitation of the study involves the number of comparisons between physiological measures and mindfulness measures across the different experimental phases. Since time domain and frequency domain measures across several experimental phases were included in correlational analyses with mindfulness variables, a large number of comparisons resulted, leading to the possibility of Type I error. Because all comparisons involved specific, planned hypotheses, no correction for Type I error was made. A procedure to adjust the p value and protect against Type I error, like Holm or Bonferroni, would have protected against the problem of multiple comparisons (Aickin & Gensler, 1996). The lack of such a correction is a limitation of the study.

Taken together, the current findings provide some support for the effectiveness of mindful skills to enhance resilience in the face of stress. Specifically, the mindful skill of describing, or the ability to put one's emotions, thoughts, and sensations into words, was associated with more effective stress regulation. It is likely that this association was brought out by the nature of the experimental protocol, which included a task requiring participants to have a conversation about a personal issue. Those who could discuss the issue and process their reactions may have experienced more resilient coping, which was reflected in increased parasympathetic self-regulation. Moreover, although it was unclear whether the mindful breathing task was associated with a reduction in physiological stress reactivity, the finding that those who felt engaged by it showed lower sympathetic reactivity suggests that even a brief breathing intervention has a positive effect on emotional resiliency.

Some hypotheses were not confirmed, as the current study failed to capture expected associations between certain mindfulness-related skills and indices of recovery from stress. This is potentially due to experimental error and limitations of various aspects of the experimental design. These aspects of the design can be improved upon in further studies, which could modify the mindful breathing exercise and manipulate the context in which it is administered. In the current research design, the exercise was administered after participants had been in a stationary position for an extended time, and they may have been experiencing restlessness, which could have affected their physiological reactivity. The protocol was administered in a seated rather than a supine position, which may have affected physiological reactivity. Future research designs might use less equipment, especially since some participants indicated it to be uncomfortable, which might be anxiety-provoking. It is possible that the measurement of BP and HR confounded results. The cuff inflation may have served as a stressor for some participants and a reminder to stay calm for others. Equipment effects on participant experience may explain lack of expected associations between mindfulness and physiological responding. Furthermore, the experimental session for various participants took place at different times of day, and even though time of day did not correlate with physiological measures, time of day is known to influence hormonal levels and experience of stress. Testing participants at different times during the day is also problematic because circadian rhythms influence cardiovascular functioning. Specifically, catecholamine levels peak just after wakening, at around 9 am, which is accompanied by increases in sympathetic functioning. Subsequently, sympathetic functioning decreases and parasympathetic functioning increases for the next several hours (Scheer et al., 2010). Hence, levels of sympathetic and parasympathetic variables were likely affected by testing participants at different times of day, which is an important limitation of this study.

In addition to the above-mentioned variables, it must be noted that because speech affects respiration and vagal tone, the fact that participants were speaking likely had an effect on heart rate variability(Appelhans & Luecken, 2006). It is a limitation of this study that respiration was used only qualitatively and not as a control variable.

Finally, the wide variability of issues discussed by participants may be problematic. It is likely that some participants chose issues less likely to cause stress, while others chose more poignant situations. The fact that the experimental task may have engaged participants to a varying degree is a potential source of experimental error.

Table 1.

Mindfulness Study Control Variables

What they measure	When data are collected
Recent caffeine/alcohol use prior to Experimental Session	At beginning of experimental session, just prior to hooking up of physiological equipment
Participants' age	At the beginning of the familiarization session
Recent physical activity	At beginning of experimental session, just prior to hooking up of physiological equipment
Participant's report of extraordinary levels of stress experienced recently.	At beginning of experimental session, just prior to hooking up of physiological equipment
Level of previous experience with mindfulness or other devotional practice (e.g., prayer)	Familiarization session – at the end of the FFMQ questionnaire
Use of medication potentially affecting blood pressure	Demographic and Health History Questionnaire – Familiarization session; first measure to be administered.
Previous psychiatric diagnosis (such as anxiety or depression)	Demographic and Health History Questionnaire – Familiarization session; first measure to be administered.
If female, when participant last experienced menstruation	Demographic and Health History Questionnaire – Familiarization session; first measure to be administered.

Table 2. *Physiological dependent variables*

What they are called and what they measure	Measurements derived	When data is collected
Heart Rate (pulse), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP)		Baseline (5 measurements), SCI (one measurement) and Recovery Phase (5 measurements)
Skin Conductance Response (SCR)		Baseline, Social Competence Interview Stress Task, Calming Phase (CP), Mindful Breathing Exercise (MBE), Recovery Baseline.
Heart Rate and Heart Rate Variability (HRV)	Low Frequency HRV, High Frequency HRV, Total Power (TP): Ratio of HFHRV to total power spectrum; Ratio of LFHRV to total power spectrum; pNN50, SDNN, RMSSD.	Baseline, Social Competence Interview Stress Task, Calming Phase (CP), Mindful Breathing Exercise (MBE), Recovery Baseline.

Table 3. *Descriptives for main outcome variables.*

Variable	Mean	SD	Range	Skewness	Kurtosis
MAAS	56.33	12.71	28.00-89.00	.07	-.09
SCR_baseline	3.04	2.90	.00-11.10	1.27	1.07
SCR_stress	8.47	4.00	.55-17.90	.26	-.31
SCR_calm	7.55	3.49	1.82-16.02	.62	-.18
SCR_MBE	2.79	2.41	.00-9.25	1.10	.45
Sympathetic measures: Change scores – skin conductance					
SCR_recovery	3.12	2.97	.10-15.68	2.00	5.42
SCR_baseline_ST*	5.43	3.71	-4.20-15.04	.10	.22
SCR_ST_to_CP	1.09	2.82	-5.54-8.03	.07	1.22
SCR_ST_to_MBE	5.68	3.34	-1.90-11.87	-.07	-.62
SCR_ST_to_recovery	5.47	3.76	-3.14-12.84	-.28	-.29
LF_HF ratio					
LF_HF_baseline	2.05	2.05	.16-8.67	1.74	2.76
LF_HF_stress	3.13	1.78	.96-9.07	1.15	1.41
LF_HF_calm	3.92	3.04	.11-11.73	1.22	1.00
LF_HF_MBE	3.15	2.94	.13-10.95	1.26	.78
LF_HF_recovery	2.21	1.75	.17-6.32	.91	-.06
LF absolute units (all values are log transformed)					
LF_baseline	2.88	.41	1.96-3.83	-.18	-.31
LF_stress	3.15	.29	2.64-3.78	.04	-.70
LF_calm	3.18	.41	1.30-4.01	-1.70	7.02
LF_MBE	3.04	.47	2.27-4.31	.29	-.42
LF_recovery	2.96	.38	2.30-3.93	.30	-.51
LF normalized units					
LF_baseline	.50	.21	.12-.82	-.25	-1.26
LF_stress	.65	.12	.35-.90	-.30	.64
LF_MBE	.58	.21	.11-.93	-.41	-.51
LF_calm	.65	.19	.01-.90	-1.02	1.28
LF_recovery	.51	.21	.14-.86	-.21	-1.15
HF absolute units (all values are log transformed)					
HF_baseline	2.73	.55	1.54-3.88	-.27	-.41
HF_stress	2.73	.38	1.97-3.62	.05	-.25
HF_MBE	2.75	.54	1.54-3.84	-.25	-.74
HF_calm	2.73	.47	1.79-4.08	.20	.06
HF_recovery	2.78	.53	1.63-3.82	-.15	-.61
HF normalized units					
HF_baseline	.38	.22	.09-.83	.68	-.73
HF_stress	.27	.11	.08-.49	.38	-.77
HF_MBE	.34	.22	.02-.88	.64	-.56
HF_calm	.25	.14	.05-.58	.65	-.45

HF_recovery	.36	.21	.08-.85	.69	-.42
Parasympathetic measures					
SDNN_baseline	47.10	22.00	13.7-106.1	.89	.53
RMMSSD_baseline	39.42	21.81	10.2-88.3	.64	-.58
pNN50_baseline	19.61	19.00	.1-68.6	.80	-.40
SDNN_stress	52.98	18.61	20.90-98.90	.63	.13
RMMSSD_stress	43.74	21.12	14.4-102.0	1.03	.75
pNN50_stress	16.02	13.00	.40-49.45	1.02	.29
SDNN_calm	55.33	20.48	29.2-122.10	1.05	1.10
RMMSSD_calm	44.58	23.88	13.6-116.6	1.38	1.79
pNN50_calm	17.36	20.48	.3-52.80	.92	-.20
SDNN_MBE	50.96	21.38	16.8-96.3	.47	-.60
RMSSD_MBE	43.74	24.09	9.90-101.6	.65	-.70
pNN50_MBE	19.06	18.45	.00-67.30	.88	-.38
SDNN_recovery	51.30	23.23	16.3-113.7	1.05	1.98
RMSSD_recovery	44.97	24.85	10.6-113.5	.93	.45
pNN50_recovery	21.97	18.93	.0-62.3	.59	-.90

Table 4. *Descriptives for cardiovascular variables and relevant control variables*.

Variable	Mean	SD	Range	Skewness	Kurtosis
Δ, Stress SBP	4.52	7.19	-10.50-23.45	.11	.12
Δ, Recovery SBP	2.85	12.30	-.20.50-.33.50	.13	-.33
Δ, Stress DBP	2.75	3.88	-5.00-10.75	.22	-.18
Δ, Recovery DBP	.42	6.55	-15.50-15.25	.13	-.33
Δ, Stress HR	1.28	4.20	-8.00-11.66	.17	.47
Δ, Recovery HR	2.46	16.24	-44.25-41.50	-.34	1.53
BMI	23.31	3.82	17.30-35.90	1.07	1.56
Age	22.89	5.94	18.08-45.64	2.43	5.69

Note. **Δ**, Stress SBP = Change in SBP from baseline to stress task SBP. **Δ**, Recovery SBP = Change in SBP from stress task to recovery. *N* = 54.

Table 5. *Correlations between mindfulness and normalized high frequency reactivity during the recovery phase based on time domain and frequency domain measures*.

	MAAS	Describe	SDNN	RMSSD	pNN50	Parasympathetic tone	Sympathetic /total ratio
MAAS	---	.31*	.18	.19	.21	.15	-.34*
Describe		--	.16	.16	.14	.32*	-.23
SDNN			--	.75**	.73**	.15	-.38**
RMSSD				--	.96**	.45*	-.49**
pNN50					--	.57**	-.56**
Parasympathetic tone						--	-.73**
Sympathetic/total ratio							--

Note. *$p < .05$. **$p < .01$. MAAS – total score of the Mindful Attention and Awareness Scale; Describe – describing subscale of the FFMQ; SDNN, RMSSD, and pNN50 – time domain measures.

Table 6. *Correlations between mindfulness variables and LF as well as HF HRV in normalized units.*

	Baseline HF	Emotional Recall Task HF	Calm phase HF	Mindful Breathing Task HF	Recovery HF
MAAS	.14	.28*	.16	.16	.16
Describe	.27*	.28*	.32*	.17	.34*

Note. *$p < .05$.

	Baseline LF	Emotional Recall Task LF	Calm phase LF	Mindful Breathing Task LF	Recovery LF
MAAS	-.13	-.22	-.05	-.24††	-.33*
Describe	-.14	-.09	-.23	-.32*	-.24†

Note. †$p = .09$; ††$p = .08$

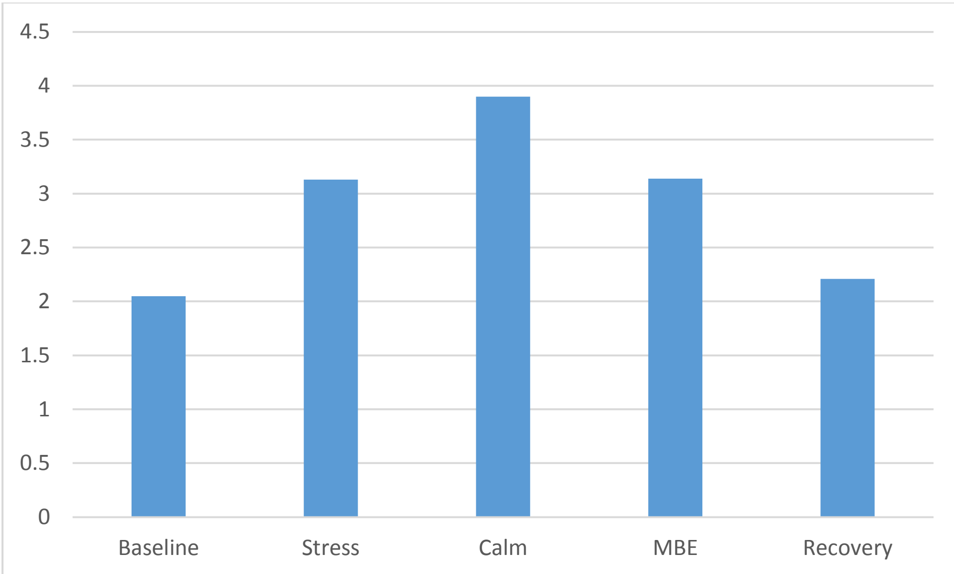

Figure 1. Sympathetic functioning expressed as a ratio of low-frequency to high-frequency heart rate variability (HRV) during each task.

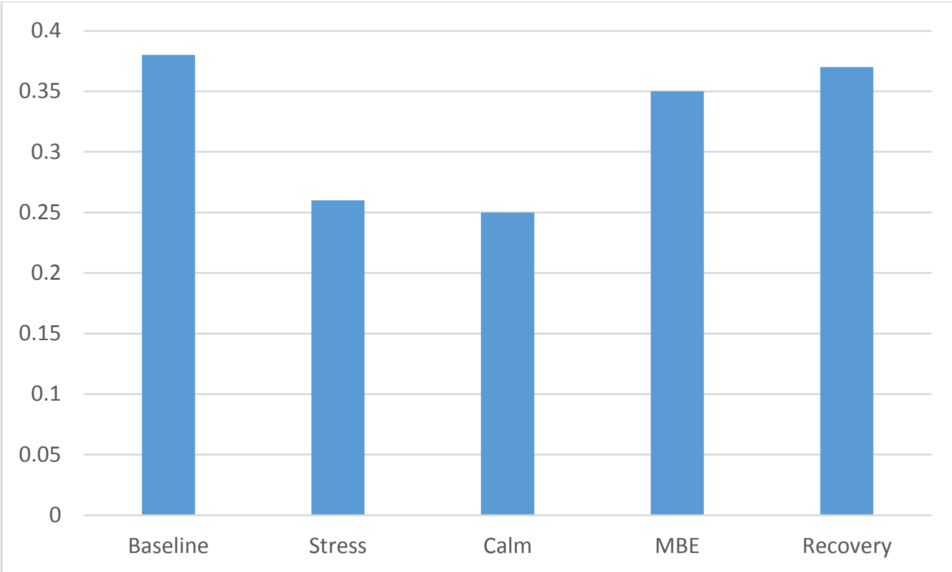

Figure 2. Sympathetic functioning expressed as a ratio of high-frequency to total power heart rate variability (HRV) during each task.

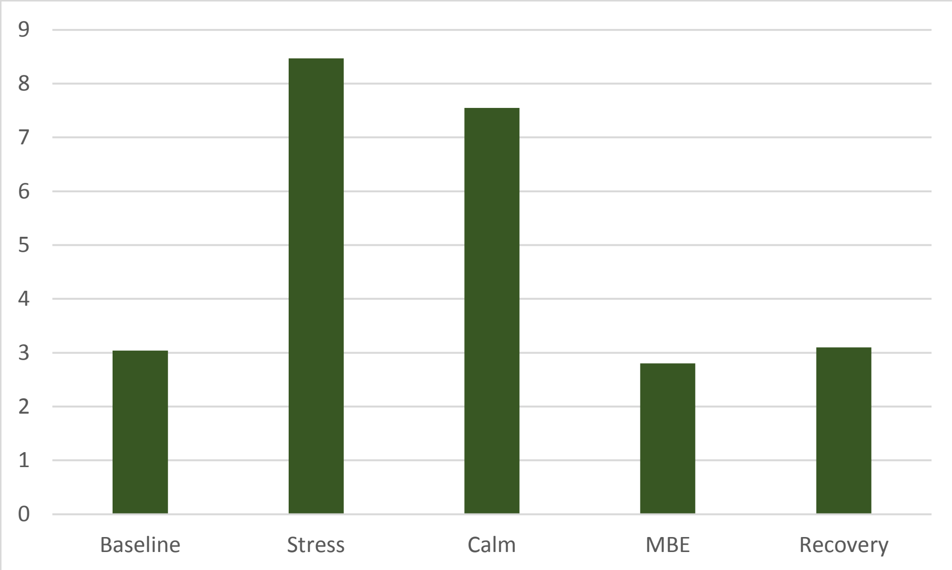

Figure 3. Sympathetic functioning expressed as average skin conductance response during each task.

CHAPTER 3

Mindfulness of Inner Experience: A Buffer against Emotional Distress

This chapter focuses on the role of mindfulness skills in lowering risk of emotional distress. Mindfulness is described in the context of clinical therapy research. Traditional constructs of emotional regulation and ‘emotional management’ are explored, as well as the alternative perspective that mindful awareness of inner experience leads to a better relationship with one’s emotions. Modern constructs of mindfulness and adult emotional dysregulation are discussed. Specifically, the self-reflective processes which support persistent dysphoric moods is described, with reference to the role of mindful awareness in ameliorating them.

Mindfulness in Research and Practice

Mindfulness is the fundamental attentional stance underlying all streams of Buddhist meditative practice (Kabat-Zinn, 2003), and has been described as the “heart” of Buddhist meditation (Thera, 1962). More recently, it has been co-opted by Western scientists and practitioners for secular practice and scientific study. It is at the core of systematic intervention programs, such as Mindfulness-Based Stress Reduction (MBSR), a structured, eight-week behavioural medicine program developed by Jon Kabat-Zinn (1990) and colleagues, which focuses on the acquisition of mindful awareness through weekly group exercises in meditation techniques, including those focused on breathing and body awareness. Another structured eight-week program, Mindfulness-Based Cognitive Therapy (MBCT) developed by Segal, Williams, and Teasdale (2002), builds on the MBSR model, but adapts it for the treatment of individuals with a history of recurring depression. Through MBCT, vulnerability to depressive relapse is addressed by teaching individuals to pay attention to their unfolding experience without judgment, in the hope that they will develop an accepting attitude towards life experiences. A number of other programs have been developed based on and flowing from MBSR and MBCT.

Documented benefits of structured mindfulness training include improvement in the self-regulation of emotions among individuals suffering from anxiety (Davidson et al., 2004), as well as promotion of resiliency and prevention of relapse among individuals suffering from depression (Teasdale et al., 2002). However, although the capacity for mindfulness can be strengthened and developed through practice, it is not an acquired skill that solely arises due to training. Rather, it is believed to be a universal, inherent human capacity (Kabat-Zinn, 2003).

Evidence of psychotherapeutic gains has driven efforts to develop testable constructs of mindfulness for rigorous scientific study. At its simplest, mindfulness is described as "the state of being attentive to and aware of what is taking place in the present" (Brown & Ryan, 2003, p. 822), where one is intentionally receptive to all mental, physical, and emotional events while refraining from judgement or evaluation of experience (Shapiro et al., 2006). It has also been conceptualized as a state supported by interacting psychological skills, such as the ability to describe one's observed experience or the capacity to remain focused without becoming emotionally aroused (Dimidjian & Linehan, 2003). These conceptualization efforts are motivated by the need to systematically measure therapeutic gain among individuals acquiring mindfulness experience, which has become an accepted component of treatment methods for emotional dysregulation.

Mindful decentering and the prevention of depressive relapse

The regulation of emotion is a crucial ability when responding to environmental demands. Traditional views of emotional regulation emphasize that it develops throughout a person's lifetime, first influenced by the temperament of the individual and the early environment (Thompson, 1994). The generation and modulation of emotion occurs on multiple interacting levels, including the biological, cognitive, and behavioural. For instance, it is believed that situational judgments, or cognitive appraisals, within the context of a certain situation, precede emotion, as cognitive re-appraisal elicits emotional reactivity (Lazarus, 1982).

During the 1990s, researchers viewed emotional regulation as the capability to manage or control emotion for the sake of attaining a specific outcome (Cole, Michel, & Teti, 1994; Thompson, 1994). This definition emphasized the monitoring of emotion for the purpose of modulating emotional expression (e.g., facing bad news without signs of displeasure) or modifying the emotions themselves through re-appraisal of the meaning of a situation (e.g., re-interpreting a difficult situation so as not to reflect negatively on the self). But, as other scientists suggest, the ability to notice and differentiate among emotions maybe be just as important as the modulation of emotions (Gross et al., 2002; Paivio & Greenberg, 1998). In their 2002 paper, Gross and colleagues develop a process model of emotional regulation, where regulation strategies are conceptualized as stages, unfolding as the individual's emotive response to a stressful or challenging situation develops. Some mention of the self-regulation of attention is made, but attention is selectively deployed to focus on certain aspects of a situation or to distract the self from others, to set the stage for cognitive re-appraisal, or organizing the meanings one attaches to a situation, which can change the emotional response.

It has long been believed that patients with depressive tendencies can learn to control their anxiety and depression and reduce vulnerability to depressive relapse through cognitive reappraisal. It is one of the main premises of the cognitive behavioural model (CBT). Essentially, through cognitive behavioural techniques, such as challenging automatic thoughts, patients weaken the hold of long-term trait-like dysfunctional attitudes (Beck, 2011). However, research has suggested otherwise. Specifically, findings have shown that although cognitive therapy has produced better long-term outcomes than pharmacotherapy, these two treatments do not show consistent differences on post-treatment measures of dysfunctional attitudes (Barber & DeRubeis, 1989). As an alternative mechanism, Teasdale et al. (2002) proposed that patients reduce their vulnerability to depression by learning to relate differently, more functionally, to depressive symptoms and problematic situations. This change is less concerned with modifying long-term trait-like dysfunctional attitudes (as was supposed by the originally conceived model of cognitive therapy) but rather dependent on a better relationship with the negative thoughts that become accessible and activated in states of mildly depressed mood (Teasdale, 1999; Teasdale et al., 2002). According to Teasdale and colleagues, patients, instead of trying to modify, reframe, or avoid their emotions, learn to actively become aware of their emotions without identifying personally with these mental events or evaluating them as true or untrue. In this way, they are able to tolerate their momentary sadness, which becomes a transient episode rather than a trigger for a bout of major depressive disorder. In support of these statements, mindfulness has shown promise when implemented as part of cognitive therapy for depression (Teasdale et al., 2002). Despite this, the relationship between mindfulness and modern models of emotional regulation among adults has rarely been examined, perhaps because emotional regulation among adults has, until the past decade, lacked a clear conceptualization (Gratz & Roemer, 2004).

Mindfulness and emotional regulation

It is important to remember that mindfulness is a state or tendency in which an individual learns to tolerate negative emotions by admitting them into awareness, but keeps these emotions from becoming self-perpetuating through skillful allocation of attention. According to Brown and Ryan (2003), the state of mindfulness is supported by emotional self-regulation skills. If so, modern constructs of mindfulness should parallel constructs of adult emotional self-regulation. In their 2004 article, Gratz and Roemer present a compelling multicomponent model of the skills needed to support healthy emotional regulation in adults. In their conceptualization, Gratz and Roemer (2004) emphasize that adaptive regulation involves not eliminating or avoiding certain emotions, as is emphasized by prominent models of emotional regulation existing at the time (e.g., Thompson, 1994), but rather awareness of and familiarity with one's own emotions, acceptance of one's own emotions, access to self-regulatory strategies, and the capacity for and also the ability to engage in desired behaviour in the presence of strong emotions, without engaging in impulsive responding. In all, these qualities of emotional regulation seem to parallel well-known concomitants of mindful attention, such as the ability to keep an open mind and observe all that occurs without judgment, while maintaining a non-reactive stance (Baer et al., 2006). These parallels will be examined in greater detail in a subsequent section.

Theoretically, mindfulness ought to protect individuals against the disruptive effects of emotional dysregulation, but this relation has not been systematically examined. Objectively confirming the association between mindful skills and emotional dysregulation is important because mindfulness skills can be developed over time. If individuals with natural mindfulness have fewer lapses of emotional regulation, then individuals with tendencies toward failure to adaptively regulate emotion, such as patients with mood disorders, could develop a better relationship with their emotions by practicing mindfulness.

Mindfulness as a buffer against rumination

Examining the effect of mindfulness training on emotional regulation is an important future avenue of research, but emotional regulation is a broad construct. Research literature on mood disorders suggests that specific ways of allocating attention towards the negative aspects of the self maintain negative moods and limit one's ability to cope actively and resolve problems. Specifically, it has been suggested that rumination can maintain dysphoric mood (Teasdale et al., 2002) and even predict depressive relapse (Nolen-Hoeksema, Wisco, & Lyubomirski, 2008).

Rumination has been described variably as a dysfunctional form of self-focus (Trapnell & Campbell, 1999), a recognition of the discrepancy between one's current state and some currently unreached standard (Duval & Wicklund, 1972), and as a repetitive or perseverative activation of self-focus on this kind of discrepancy, where multiple judgments and comparisons are elicited, causing the maintenance of negative affect (Nolen-Hoeksema et al., 2008). Past literature has recognized the existence of two distinct types of self-focus, where attention is directed inward toward the self. Specifically, a person may engage in anxiously motivated self-focus, in a more neutral type of self-directed contemplation, emphasizing self-understanding to deal with and attempt to overcome problems and difficulties (Treynor, Gonzalez, & Nolen-Hoeksema, 2003), or curiosity about the self (Trapnell & Campbell, 1999). Only the former type of inward-directed focus is associated with depressive symptoms (Mor & Winquist, 2002). It is a state where attention seems fixated on emotional distress and the possible causes and consequences of the depressive symptoms, as the individual accesses memories of past adverse events (Nolen-Hoeksema et al., 2008). In fact, it has been suggested that biases in autobiographical memory underlie ruminative self-focus, whereby individuals with a tendency to ruminate may find negative memories much more accessible than pleasant memories (Teasdale & Green, 2004). Teasdale et al. (1999) refer to this repetitive thought process as a self-perpetuating 'depressive interlock', where individuals derive negative meanings about the self as they rehash past negative experiences, and then treat these negative conclusions (e.g., "I'm not good at anything") as factual information. In this way, individuals are likely to enter a depressive episode, and once in it, are likely to remain depressed, leading to consequences which include impaired problem-solving and eroded social support (Nolen-Hoeksema et al., 2008). In sum, due to rumination, individuals remain stuck in a negative mood due to differences between their current thoughts and a desired state. Furthermore, the individuals misidentify their biased or maladaptive thoughts as facts.

This aspect of rumination, whereby individuals identify thoughts as facts, suggests that the development of mindful awareness may have an effective role in stemming ruminative processes. According to Teasdale et al. (1999), the ability to tolerate strong emotions, such as those that develop during transient distress, is dependent on the ability to decenter, or to recognize that one's emotions and interpretations of experience do not necessarily define the self. In the mindful process, the intentional allocation of attentional resources is of great importance (Bishop, 2004). Instead of investing significant effort and attention trying to down-regulate strong emotions through cognitive reappraisal, which may not be an optimal technique due to previously documented weaknesses in cortical top-down regulation of limbic reactivity among individuals with mood disorders (Farb et al., 2012), individuals with a tendency to ruminate and induce lasting states of emotional distress may benefit from a more ‘pre-reflexive’ focus on their experience. Farb et al. (2012) described mindful open awareness as a ‘pre-reflexive’ state where attentional resources are diverted towards recognition of unfolding thoughts, emotions, and sensory experiences. When attention is anchored to a physical process, such as the breath, and is brought back non-judgmentally and with purpose each time attention wanders, the tendency to dwell on negative meanings is reduced.

In fact, research literature on mood disorders and cognitive behavioural therapy suggests that mindfulness training supports the development of improved emotional self-regulation skills, while stemming rumination about negative emotions and negative thoughts (Teasdale et al., 2000; Teasdale et al., 2002). However, the question of whether mindful individuals’ healthier ability to self-regulate emotion and attention is reflected in a reduced propensity to experience rumination has rarely systematically and comprehensively been evaluated in research. Typically, in the context of mindfulness-treatment outcome studies, evaluation consists of measuring individuals’ reduction in anxiety and depressive symptoms half-way through or at the end of treatment (Grossman et al., 2004). There is rarely an in-depth examination of any self-regulatory advantages associated with mindful self-awareness and whether these benefits persist.

To define the role of mindful attention in promoting emotional self-regulation and stemming ruminative processes, valid methods of measurement are necessary. The next section will describe selected measurement scales of mindfulness, emotional regulation and rumination, with emphasis on why they are believed to adequately capture constructs of interest.

Clarifying the Constructs of Interest and Their Measurement

Mindfulness and emotional self-regulation measures. It has been noted by mindfulness researchers that the mindful state is supported by skills of attention regulation (Bishop, 2004). The ability to switch attentional foci and to sustain attention prevents unhealthy elaborative processing of emotional information and helps introduce a space between one's perception and response, preventing impulsive responding (Bishop, 2004; Shapiro et al., 2006). In addition, the state of being attentive to, and aware of, what is taking place in the present supports the admission into awareness of emotions and impressions that may be uncomfortable, facilitating the familiarity with one's own emotions that individuals who have problems with emotional regulation often lack (Gratz & Roemer, 2004). Thus, mindfulness appears to be a state supported by interacting but distinct processes and attitudes. The Five Factor Mindfulness Questionnaire (FFMQ) explicitly articulates the skills and attitudes that maintain the mindful state (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). The FFMQ model emphasizes familiarity with one's inner experience. The mindful person must not only be aware of current emotional states, thoughts, and sensations as they unfold through observation, but must also be able to describe them in words. In fact, mindful persons tend to score lower than average on the dimension of alexithymia, which includes a lack of interest in one's emotional life as well as a difficulty in identifying and describing feelings. Baer, Smith, Hopkins, Krietemeyer, & Toney (2006) correlated mindfulness and alexithymia and found them to be moderately negatively associated. Baer and colleagues (2006) stress the accepting quality of mindful observation, whereby the individual approaches all experience without being compelled to evaluate whether it is good or bad, true or untrue. These processes parallel the components of the Gratz and Roemer (2004) multi-component model of emotional regulation, the Difficulties in Emotion Regulation Scale (DERS), which emphasizes the awareness and understanding of emotions with an attitude of acceptance.

The FFMQ model also emphasizes conscious action. The mindful person carries out activities with awareness, as opposed to functioning absent-mindedly, or on 'automatic pilot', and refrains from reacting to strong emotional stimuli. Thus, the person may be aware of transient emotions, but is not compelled to react angrily or attempt to deaden the emotion by using drugs or alcohol. Similarly, Gratz and Roemer (2004) argue that for effective emotional regulation, the individual must be able to engage in goal-directed behaviour but refrain from impulsive behaviour, even when experiencing negative emotion.

Finally, Gratz and Roemer (2004) include a dimension that captures access to effective emotional regulation strategies, or the degree to which an individual is aware of and able to select emotional regulation strategies perceived as effective. According to Gratz and Roemer, with this final dimension of their model, they aim to measure the flexible use of situationally appropriate strategies to modulate emotional responses. Emotional self-regulation techniques are context-dependent and what works in one situation may not work in another. For example, though going for a walk may help when one is upset, it is not always possible to do this in the middle of a conversation. According to Bishop (2004), the practice of mindfulness results in lower experiential avoidance and a more flexible ability to frame and reframe cognitive and affective experience. By this token, individuals who rate themselves highly on a measure of mindful awareness, such as the FFMQ, should also be more aware of the repertoire of self-regulatory techniques and be more confident in using them. However, it is difficult to justify which dimension of the mindful construct would most closely approximate the ability to effectively select methods of self-regulation.

Measurement of rumination. As mentioned above, rumination, conceptualized as repetitive and passive brooding on one's negative emotions (Siegle, Moore, & Thase, 2004; Treynor, Gonzalez, & Nolen-Hoeksema, 2003) is distinct from healthy self-reflection in preparation to cope with one's problems (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). In measuring the construct of rumination, it is important to recognize these dimensions as separate, especially when one is also assessing mindful self-awareness, which may be closely associated with healthy self-focus. The Reflection Rumination Questionnaire (RRQ; Trapnell & Campbell, 1999) differentiates trait ruminative self-focus and reflective self-focus as personality dimensions, associated with neuroticism and openness-to-experience, respectively (Trapnell & Campbell, 1999).

Particular facets of the mindfulness construct are likely to function as a buffer against ruminative tendencies. According to Nolen-Hoeksema et al. (2008), rumination is associated with biases in information processing, whereby certain aspects of experience are avoided and others, such as memories of negative events, are excessively focused on. The mindful skill of observing, which Baer and colleagues (2006) defined as the ability to be aware of all emotional states, thoughts and sensations as they unfold, is in opposition to the avoidance of experience, and is especially likely to be negatively associated with rumination. Nolen-Hoeksema et al. (2008) also noted that while ruminating, individuals tend to make self-critical judgments and comparisons and treat these statements as fact, which results in pessimism and avoidance of problem-solving. Alternatively, mindfulness research stresses the accepting quality of mindful observation, which Baer and colleagues (2006) captures with the non-judge dimension of the FFMQ scale. In sum, the observe and non-judge dimensions of the FFMQ are particularly likely to counter-act the tendency to ruminate.

The Present Study

As mentioned previously, mindfulness training is a component of multiple psychotherapeutic interventions. Mindfulness intervention studies commonly use anxiety and depression outcome measures as a yard-stick of effectiveness of therapy and to understand if gains have been made (Hofmann, Sawyer, Witt & Oh., 2010). In these studies, therapy clients typically show an improvement that, on average, is clinically significant. However, there is little understanding of the mindfulness processes responsible for improvement among those that improve, or the lack of mindfulness skills among those that do not (Grossman, Niemann, Schmidt & Walach., 2004). The current study aimed to address this gap by exploring the relations among mindfulness, emotional regulation skills, and rumination.

It is believed that mindfulness supports improved emotional and attentional self-regulation skills. According to Teasdale and colleagues (2002), mindfulness supports emotional regulation as individuals learn to become aware of negative emotions and thoughts triggered in states of mildly depressed mood, without identifying personally with these events and evaluating them as true or untrue. In this way, cognitive therapy patients bring previously avoided emotions into consciousness, learn to recognize their emotions, and learn to perform goal-related activities despite the presence of strong feelings. Hence, Teasdale's work suggests that through the development of mindfulness skills, emotional regulation skills can also be achieved. If the presence of mindful tendencies, measurable through self-report scales such as MAAS and FFMQ, aids development of self-regulation skills even among patients with mood disorders, then it would be expected that individuals with strong self-rated mindfulness skills are less prone to clinical levels of anxiety and depression, and also less prone to difficulties with emotional dysregulation and rumination. But, as mentioned previously, these relations are rarely validated in research designs. The current study aimed to address this gap and answer the following research questions empirically: 1) Are natively mindful individuals less prone to clinical depression and anxiety?; 2) Are mindful individuals less prone to emotional regulation difficulties?; and 3) Do mindful individuals display lower tendencies to ruminate relative to other individuals, especially in the presence of mildly dysphoric emotions? The value of examining these associations in a meditation-naïve population would be to show that mindfulness can become a stable tendency and, as such, a set of skills that can be maintained and tapped into to reduce relapse into or prevent mood disorders.

Hypotheses

Hypothesis I. Mindfulness was expected to negatively correlate with anxiety and depression.

Hypothesis II. Mindfulness was expected to be negatively associated with self-reported proneness to emotional regulation difficulties. Specifically, it was expected that mindfulness would be negatively associated with difficulties in recognizing and accepting their emotions, performing goal-related activities despite the presence of strong emotions, and accessing emotional regulation strategies perceived as effective.

Hypothesis III. Mindfulness was expected to be negatively associated with rumination (the general tendency to reflect anxiously or gloomily on their emotions) (see Figure 1).

Hypothesis IV. Mindfulness was expected be negatively associated with rumination Mindful individuals were expected to report lower scores on rumination, even following discussion of a recurrent stressor experienced in daily life (see Figure 1).

Hypothesis V. Mindfulness was expected to be negatively associated with symptoms of alexithymia.

Methods

Power Analysis

Hypothesis I. To determine the number of participants needed to detect whether mindfulness would be negatively associated with anxiety and depression symptoms, literature was searched for studies using linear regression or bivariate correlation to examine the association of mindfulness, mood and affect variables. Studies examining the correlations among mindfulness, anxiety and depression have yielded moderate effect sizes (Brown & Ryan, 2003; Curtiss & Klemanski, 2014; Ostafim, Brooks, & Laitem, 2014). An *a priori* power analysis was conducted with the program G*Power (Erdfelder, Faul, & Buchner, 2007) for a bivariate correlational analysis, yielding a recommended sample size of 67 participants for a moderate effect size.

Hypothesis II. To determine the number of participants needed to detect associations between mindfulness and proneness to emotional regulation difficulties, literature was searched for studies examining mindfulness and emotional dysregulation. No studies using canonical correlations were found, but correlational studies yielded moderate negative correlations between mindfulness and indices of emotional regulation (Baer et al., 2006; Atkinson & Wade, 2012). According to Stevens (2002), a sample size of 100 is needed to detect a moderate canonical correlation about 67% of the time. For canonical correlation analysis, sample sizes of at least 10 to 20 participants per variable are recommended (Stevens, 2002). As there are 10 variables involved in this analysis, a recommended sample size of 200 participants was calculated.

Hypothesis III and IV. To determine the number of participants needed to detect whether mindfulness (on the non-judge and observe dimensions of the FFMQ) and the MAAS would be negatively associated with rumination while controlling for age and sex, an *a priori* power analysis was conducted with the program G*Power (Erdfelder, Faul, & Buchner, 2007) for a linear multiple regression with three predictors for a medium effect size, yielding 55 participants.

Hypothesis V. According to past literature on alexithymia and mindfulness, correlations for a sample size of 300 yielded small (non-react), medium (acting with awareness and non-judgement) and large (observe) effects across scales of the FFMQ (Baer et al., 2006). For canonical correlation analysis, sample sizes of at least 10 to 20 participants per variable are recommended (Stevens, 2002). As there are 10 variables involved in this analysis, a recommended sample size of 200 participants was calculated.

Participants

Following from the power analyses, 250 University of Windsor undergraduate student participants were recruited through the University of Windsor undergraduate psychology participant pool (see Figure 1). Only students who reported a fluent knowledge of English at the time they were screened for the participant pool were included. There were no other exclusionary criteria. This group of participants was asked to fill out self-report measures of mindfulness, emotional self-regulation, and rumination. Blocks of measures were administered, including 1) health and demographic data, 2) mindfulness, consisting of the MAAS and FFMQ questionnaires, 3) emotional self-regulation and rumination, consisting of the DERS and RRQ questionnaires, and 4) the TAS-20 alexithymia measure (see Figure 2). The order of administration of measures was fully randomized within blocks 2 and 3 in order to eliminate carryover effects.

In the second wave of data collection involving a laboratory task, an additional fifty-five participants unique to the original 250 were recruited through the University of Windsor undergraduate psychology participant pool (see Figure 1). These are the same participants that were recruited in Chapter 2. They took part in an interview about a recurring stressor, and their physiological indices were monitored as they spoke. Following the task, calming and recovery baseline phases were administered, physiological equipment was unhooked, and participants were asked to answer self-report measures about their general ruminative tendencies. Students with a history of allergies to medical equipment (e.g., latex allergy) and with cardiovascular and respiratory disease were excluded through the screening criteria (see Figure 3). Students who indicated that they are not fluent speakers of English were also excluded, due to the nature of the interview task, which involves participants in recalling emotions and thoughts. There were no other exclusionary criteria for this group.

Measures

Demographic information. A *Demographic and Health Questionnaire* was used to collect data about the participants' physical and mental health history as well as any recent caffeine use. This questionnaire was previously described in Chapter 2.

Mindfulness measures. *The Five Factor Mindfulness Questionnaire* (Baer, Smith, Hopkins, Krietemeyer, & Toney., 2006) is a five-factor self-report assessment measure created following an exploratory factor analysis, which used a combined item pool from five questionnaires measuring mindfulness as a trait or tendency in daily life. It is designed for use among populations with little to no mindfulness experience. The resulting measure has 39 items and five factors representing distinct but related dimensions: observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. Items are rated on a Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). All five factors show adequate to good internal consistency, with the following Cronbach's alpha coefficients: Nonreactivity = .75, Observing = .83, Acting with Awareness = .87, Describing = .91, and Non-judging = .87. The FFMQ has shown significant relationships in the predicted directions with a variety of constructs related to mindfulness (Baer et al. 2006). The Describe scale has shown large positive correlations with emotional intelligence ($r(298) = .60$, $p<0.001$) and a negative correlation with alexithymia ($r(298)= -.68$, $p<0.001$). The Observe scale was positively correlated with openness-to-experience ($r(298) = .42$, $p<0.001$). The Non-React subscale was positively correlated with self-compassion ($r(298)=.53$, $p<0.001$). In addition, all factors except Observe yielded moderate negative correlations with maladaptive psychological symptoms. Surprisingly, previous research suggests Observing is positively correlated with psychological symptoms, including dissociation, absent-mindedness, and thought suppression (Baer et al., 2006).

The *Mindfulness Practice - History Questionnaire* (Baer, Smith, & Allen, 2004). Along with the 39-item FFMQ scale, participants also completed a short questionnaire assessing any previous experience with meditation and other devotional practices. This six-item questionnaire asks participants to rate the length of time for which they may have been involved with each practice.

The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) is a 15-item measure of individual differences in the frequency of mindful states over time, using a 6-point Likert scale from 1 (almost always) to 6 (almost never). High scores are said to reflect better-developed mindfulness skills. The items tap into cognitive, emotional, sensory, and interpersonal domains. It is a single factor scale with strong internal consistency, indicated by a Cronbach alpha of .82 for the student sample of 60 participants and .87 for a general adult sample of 239 participants (Brown & Ryan, 2003). As predicted, the MAAS was correlated with several sub-scales of the Trait Meta-Mood Scale, including clarity of emotional states ($r(311) = .49$; $p<.001$), mood repair ($r(311) = .37$; $p<.001$) and attention to emotions ($r(311) = .19$; $p< .001$). The MAAS also showed a modest positive correlation with the NEO-PI openness-to-experience (r $(311) =.18$; $p<.01$), and a negative correlation with Social Anxiety ($r(311)=-.36$; $p<.001$).

Beck Depression Inventory, Short Form (BDI-SF; Beck & Beck, 1972) is a 13-item self-report inventory that measures characteristic attitudes and symptoms of depression (Appendix I). It is a widely-used measure of current depressive symptoms, often used for screening purposes. Relative to the full 21-item version, the 13-item BDI focuses on cognitive and somatic symptoms of depression, especially the cognitive symptoms, while leaving out some items that do not directly reflect core symptoms of depression (e.g., I feel I'm being punished) or that can have multiple causes (e.g., sleep problems, weight loss). Pearson product-moment correlation coefficients between the BDI and the BDI-SF have ranged from .89 to .97 indicating that the short form is an acceptable substitute for the long

(Beck, Rial, & Rickets, 1974). The BDI-13 demonstrates good concurrent validity with other measures of depression (Aalto, Elovainio, Kivimäki, Uutela, & Pirkola, 2012) and correlates highly with the longer versions of this inventory.

State-Trait Anxiety Inventory – Form Y (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is a 40-item measure of state and trait anxiety (see Appendix J). The inventory is composed of two 20-item subscales: The State Anxiety Subscale (S-Anxiety), which evaluates the participants' current state of anxiety, and the Trait Anxiety Subscale (T-Anxiety), which evaluates relatively stable aspects of "anxiety proneness", or the tendency to frequently experience states of anxiety (see Appendix I). The S-Anxiety subscale asks how participants feel "right now", emphasizing current feelings of apprehension, nervousness, tension, and worry. The T-Anxiety subscale asks participants about broad tendencies, such as how calm, stable or nervous they generally feel. Items are rated on a 4-point scale, and scores vary from a minimum of 20 to a maximum of 80. Higher scores are correlated with higher levels of anxiety. Internal consistency coefficients for the scale have ranged from .86 to .95; test-retest reliability coefficients have ranged from .65 to .75 over a 2-month interval (Spielberger et al., 1983). The measure has shown adequate convergent and discriminant validity with other measures of state and trait anxiety (Spielberger, 1989). Trait anxiety has also demonstrated strong correlations with measures of anxiety sensitivity (e.g., Koszycki & Bradwejn, 2001; Zvolensky, Feldner, Eifert, & Stewart, 2001). Past research on single session mindfulness intervention also suggests that the state measure is sensitive to transient changes in anxiety following a short intervention (Rausch, Gramling, & Auerbach, 2006).

Emotional Dysregulation. *The Difficulties in Emotional Regulation Scale* (DERS; Gratz & Roemer, 2004) is a 36-item self-report measure of skills and tendencies believed to underlie the adaptive regulation of emotions (see Appendix K). DERS items are coded so that higher scores in every case indicate greater difficulties in emotional regulation (i.e., greater emotional dysregulation). The scale yields a total score reflecting overall difficulties in emotional regulation, as well as six separate scores reflecting six distinct dimensions, which include non-acceptance, difficulties engaging in goal directed behaviour, impulse control difficulties, lack of emotional awareness, limited access to emotional regulation strategies, and lack of emotional clarity. Participants were asked to rate how often the items apply to themselves on a Likert scale ranging from 1 (almost never) to 5 (almost always). The measure showed good internal consistency, with a Cronbach's alpha coefficient of .93 for the entire scale. All of the six subscales also showed adequate internal consistency, with Cronbach alpha's above .80 for each scale. The DERS has shown significant relationships in the predicted direction with a variety of constructs related to emotional regulation (Gratz & Roemer, 2004). Specifically, the DERS was found to strongly negatively correlate with the Generalized Expectancy for Negative Mood Regulation Scale (NMR; Catanzaro & Mearns, 1990), a measure of emotional regulation ($r(348) = -.69$, $p < .01$), and strongly positively correlate with a measure of the propensity to avoid one's emotional experience ($r(348) = .60$; $p < .01$). It also showed a moderate correlation with emotional expressivity ($r(348) = -.23$; $p < .01$). The DERS scale has also shown good test-retest reliability over a period of 4 to 8 weeks ($r = .88$; $p < .01$; Gratz & Roemer, 2004).

Rumination. *Rumination Reflection Questionnaire (RRQ).* (Trapnell & Campbell, 1999) is a 24-item self-report scale developed to distinguish between adaptive and maladaptive forms of self-attentiveness (see Appendix L). Participants are asked to rate how often the items apply to themselves on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale yields two scores based on two 12-item sub-scales, including rumination, with a perseverative focus on perceived threats, losses, and injustices to the self, and reflection, or with items emphasizing intellectual curiosity about the self. Trapnell and Campbell (1999) report that reflection and rumination appear to be essentially independent constructs. Both sub-scales showed good internal consistency, with Cronbach alphas of .90 for rumination and of .91 for reflection. The RRQ subscales have shown significant relationships in the predicted direction with a variety of constructs related to personality, mood and information processing. Specifically, rumination was found to have large positive correlations with the neuroticism factor of the Five Factor Model (FFM; Digman, 1990) of personality, based on convergent correlations (r=.57 to r=.64; p<.01), while reflection only small positive correlations with neuroticism, based on convergent correlations (r=.14 to .18; p<.01). Reflection was found to show large positive correlations with the openness-to-experience factor of the FFM, showing convergent correlations (r=.61 to .68; p<.01), while rumination did not show correlations with this construct (Trapnell & Campbell, 1999). Sample sizes ranged from 447 to 710 (Trapnell & Campbell, 1999). The rumination subscale was also found to be moderately positively associated with current depressive symptoms (r(347) = .45; p<.01), while the reflection subscale was found to be uncorrelated with depressive symptoms (Siegle, Moore, & Thase, 2004). Hence, rumination and reflection were differentially related to openness-to-experience and depression.

Alexithymia. *The Toronto Alexithymia Scale – Twenty Items* (TAS-20; Bagby, Parker & Taylor, 1993) is the most commonly used measure of alexithymia, a construct defined as difficulties identifying and describing one's feelings, an impoverished fantasy life, and an externally-oriented thinking style (Lyvers, Makin, Toms, Thorberg & Samios, 2014).

The TAS-20 was used to help establish concurrent negative validity with the mindfulness scales, and may be expected to correlate negatively with the describe dimension of the FFMQ scale. In fact, Baer, Smith, Hopkins, Krietemeyer and Toney (2006) correlated the FFMQ and alexithymia using the TAS-20 and found negative associations for most subscales of the FFMQ, including describe ($r(298)=-.68$, $p<.001$), acting with awareness ($r(298) = -.42$, $p<.001$), non-judgment ($r(298) = -.34$, $p<.001$), and non-react ($r(298)=-.19$, $p< .001$). Participants are asked to rate how often the items apply to themselves on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Five of the items (4,5,10,18, and 19) are reverse scored. The individual items also load on three factors: Difficulty Describing Feelings (DDF; e.g., "People tell me to describe my feelings more"), and Difficulty Identifying Feelings (DIF; e.g., "I have feelings that I can't quite identify"), and Externally Oriented Thinking (EOT, e.g., "I feel close to someone, even in moments of silence," reverse scored). The score for each subscale was computed by summing the responses for that factor. The three factors have been found to be moderately strongly correlated (from .10 to .65) for a sample of 401 students (Babgy et al.,1994b). The TAS- 20 has demonstrated good internal consistency (Cronbach's alpha = .81) and test-retest reliability (.77, $p<.01$) (Bagby et al., 1994b). Items are summed within each subscale and then overall to create total scores that range from 20 to 100, with higher scores indicating a greater level of alexithymia. Cut-off scores have been empirically derived for the TAS-20, whereby ≥61= alexithymia and ≤51=no alexithymia (Bagby et al., 1994b).

Procedure

Data collection for the Mindful Attention and Awareness Scale (MAAS), the Five Factor Mindfulness Questionnaire (FFMQ), the Mindfulness-History Form, the Beck

Depression Inventory (BDI), the State-Trait Anxiety Inventory (STAI), the Difficulties in Emotion Regulation Scale (DERS), the Rumination Reflection Questionnaire (RRQ), and the Response Style Questionnaire (RSQ) took approximately one hour. Participants were tested in groups of 5-10. An independent phase of data collection took place over two sessions, in a comfortable, quiet laboratory room. During the initial Familiarization Session, previously described in Chapter 2, data on mindfulness skills were collected, as participants filled out the Mindful Attention and Awareness Scale (MAAS), the Five Factor Mindfulness Questionnaire (FFMQ), and the Mindfulness-History Form, following the informed consent. Within approximately two weeks, participants returned for the second session, also described in Chapter 2. During this session, participants participated in an emotional recall task, an interview in which they were guided to discuss an issue that causes them recurrent stress. After the recovery baseline and the unhooking of the physiological equipment, which follow the administration of the Social Competence Interview, participants filled out the Rumination Reflection Questionnaire (RRQ) and the Response Styles Questionnaire (RSQ).

Results

Data Analysis

Data pre-processing and reduction. Prior to processing, missing data for all self-report variables were analyzed and found to be missing randomly using the IBM SPSS 23 Statistics Missing Value Analysis (MVA) procedure. Because the analysis revealed less than

5% missing data across all main dependent variables, the SPSS Estimation Maximization procedure was used to fill in missing data.

Pre-processing of data. All main variables, including mindfulness, anxiety (STAI), depression (BDI-13), and emotional regulation (DERS) were checked using the SPSS Explore command, yielding histograms and scatterplots, which were visually inspected for influential outliers. Four cases with extreme outlier values were eliminated from the sample. Extreme outlier values were defined as numbers beyond the interquartile range, or the range encompassing the middle 50% of scores, where Q1 corresponds to the 25th percentile and Q3 corresponds to the 75th percentile of scores. Extreme outlier values were identified as any value lying above Q3 - 1.5*IQR or below Q1-1.5*IQR. Following elimination of extreme outliers identified by the SPSS histograms, descriptive data for all variables revealed them to be normally distributed (skewness was within +-2 and kurtosis within +- 3). Descriptives are summarized in Table 1. Analyses are addressed below and organized by hypothesis.

Main Analyses

Hypothesis I. To address the research question, whether mindful individuals would be less likely to suffer from depression and anxiety, correlations between mindfulness, depression, and anxiety variables were calculated using the SPSS 23 statistical package. Mindfulness (MAAS) was moderately negatively associated with depression [$r(252) = -.47$, $p<.001$] as well as trait anxiety [$r(252) = -.42$, $p<.001$] and state anxiety [$r(252) = -.47$, $p<.001$]. Individual facets of mindfulness, including nonjudging, describing, acting with awareness, and non-reactivity to inner experience dimensions were negatively associated with trait anxiety [$r(252) = -.35$ to $-.40$, $p<.001$] and state anxiety [$r(252) = -.33$ to $-.46$, $p<.001$]. Non-judging, describing, acting with awareness, and non-reactivity to inner experience dimensions were also negatively associated with depression [$r(252) = -.32$ to $-.47$, $p < .001$]. No association between the observe dimension of the FFMQ and anxiety or depression symptoms was found.

Following correlations with control variables, hierarchical regressions were calculated using the SPSS 23.0 statistical package to determine whether mindfulness predicted the variables of interest, independent of gender, age, and previous diagnosis. T-tests showed that groups with the presence of a psychiatric diagnosis and those without differed on self-reported mindfulness and self-rated depression.

A hierarchical multiple regression was performed to investigate the association of mindfulness with depression symptoms, after controlling for the presence of psychiatric diagnoses. In the first step of the model, the psychiatric diagnoses variable was entered. This model was statistically significant at $F(1, 245) = 28.46$; $p < .001$ and explained 10.40% of the variance in depression. After entry of mindfulness in Step 2, the total variance explained by the model was 30.10%. The introduction of mindfulness explained an additional 20.00% in depression, after presence of psychiatric diagnoses was controlled for (R^2 change = 0.20; $F(2,244) = 52.57$; $p < .001$) (See Table 2).

A second hierarchical multiple regression was performed to investigate the association of mindfulness with anxiety symptoms, after controlling for gender. In the first step of the model, gender was entered. This model was statistically significant at $F(1, 245) = 5.18$; $p < .05$ and explained 2.1% of the variance in anxiety (see Table 3), as being female was associated with greater trait anxiety. After entry of mindfulness in Step 2, the total variance explained by the model was 19.10%. The introduction of mindfulness explained an additional 17.02% in anxiety, after presence of gender was controlled for (R^2 change = .17; $F(1,244) = 28.81$; $p<.001$) (see Table 3).

A third hierarchical multiple regression was performed to investigate the association of mindfulness with anxiety symptoms, after controlling for age. In the first step of the model, age was entered. This model was not statistically significant, as age was not associated with greater trait anxiety. After entry of mindfulness in Step 2 the total variance explained by the model was 12.4%, representing the association between mindfulness and anxiety, at $F(1,244) = 17.12$, $p < .01$ (see Table 4).

Hypothesis II. To address the research question of whether a multivariate relationship exists between mindfulness skills and emotional self-regulation skills, a 6x3 canonical correlation was conducted using the 9.4 SAS statistical package. Canonical variables included the MAAS and the five subscales of the FFMQ, which includes describing, observing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. The outcome variables included the following DERS subscales: difficulties in recognizing and accepting emotions, performing goal-related activities despite the presence of strong emotions, and accessing emotional regulation strategies perceived as effective. Table 5 presents part of the correlation matrix from which the canonical roots were generated. As summarized in the table, mindfulness self-ratings were moderately negatively related to self-rated difficulties with emotional regulation. Specifically, the stronger one's self-ratings on the non-judge dimension, or self-acceptance of one's feelings, thoughts, and sensations without judgment, the less likely one was to report difficulties with non-acceptance of emotional responses and lack of access to emotional regulation strategies. Table 6 shows the canonical functions that were generated. Three canonical functions were reported to be significant (p<.01). Table 7 shows the canonical loadings of those functions.

The standardized and squared structure coefficients pertaining to the first canonical function of mindfulness variables, which accounted for 57% of the variance in the corresponding linear combination of difficulties in emotional regulation outcome variables, revealed that four mindfulness canonical variables were meaningfully correlated with the first canonical variant, namely mindful awareness of experience without judgment (MAAS; r^2 = .45), as well as the FFMQ dimensions non-judge (r^2 = .61), describe (r^2 = 45), and non-react (r^2 = .42). From the difficulties in emotional self-regulation outcome variable set, all three variables were revealed to be meaningfully negatively correlated with the canonical variant, but particularly non-acceptance of emotional responses (r^2 = -.67) and limited access to emotional regulation strategies (r^2 = -.77) (see Table 7). This analysis suggested that students who rated themselves highly on mindful abilities, particularly the tendency to describe their experience as well as to non-judgmentally perceive emotions, thoughts, and other aspects of experience without reacting to them, were less likely to report limited emotional regulation strategies and non-acceptance of emotional responses. A redundancy analysis was also carried out, and resulted in a pattern consistent with the matrices of canonical coefficients and correlations. The redundancy analysis showed that non-judgment of experience accounted to the greatest amount of variance (35%) in the DERS emotional regulation outcome variables as a group, but variance accounted for by the other canonical variables with meaningful contributions, including mindful awareness of experience without judgment (MAAS), as well as the FFMQ dimensions non-judge, describe, and non-react, was similar, ranging from 25% to 26% (see Table 8).

The second canonical correlation, which accounted for 26% of the variance in the corresponding linear combination of outcome variables, revealed that three mindfulness canonical variables were meaningfully correlated with the second canonical variant, namely the FFMQ dimensions of non-judge (r^2 = -.29), describe (r^2 = .30), and observe (r^2 = .37). From the difficulties in emotional self-regulation outcome variable set, non-acceptance of emotional responses (r^2 = .19) and particularly lack of emotional awareness (r^2 = -.65) were meaningfully correlated with the second variant (see Table 7). This analysis suggested that students who rated themselves low on non-judgment, or the tendency to accept one's experience non-judgmentally, also tended to score somewhat higher on non-acceptance of emotional responses. The propensity to observe and describe one's experience in the present moment was also strongly associated with lower scores on non-acceptance of emotional responses within this linear equation. When a redundancy analysis was carried out, it resulted in a pattern that differed from the matrices of canonical coefficients and correlations. The redundancy analysis showed that non-judgment of experience accounted for the greatest amount of variance (43%), followed by describe (34%) in the DERS emotional regulation outcome variables as a group, but variance accounted for by observe (11%) was lower than that of other canonical variables with meaningful contributions to the second canonical variate, revealing that once shared variance between the canonical variables was taken into account, the associations suggested by the second linear equation were altered (see Table 8).

The standardized and squared structure coefficients pertaining to the third canonical function, which accounted for 5% of the variance in the corresponding linear combination of outcome variables, revealed that three mindfulness canonical variables were meaningfully correlated with the third canonical variant, namely non-react (r^2 = .30), as well as, to a weaker extent, the FFMQ dimensions describe (r^2 = -.10) and aware (r^2 = .14). From the difficulties in emotional self-regulation outcome variable set, limited access to emotional regulation strategies (r^2 = -.19) and non-acceptance of emotional responses (r^2 = .12) were weakly correlated with the canonical variant (see Table 7). When a redundancy analysis was also carried out, it resulted in a pattern that differed from the matrices of canonical coefficients and correlations. The redundancy analysis showed that while non-reactivity to experience accounted for 27% in the DERS emotional regulation outcome variables as a group, describe and aware accounted for 35% and 23% of the variance respectively. However, the other canonical variables, which did not meaningfully contribute to the third canonical variate based on standardized and structure coefficients in Table 7, also accounted for a comparable amount of variance in outcome variables. Hence, associations suggested by the third linear equation failed to take into account shared variance between the canonical variables.

Hypothesis III. Three hierarchical regressions were run using the SPSS 23 statistical package to examine whether MAAS, non-judging, and describing predicted rumination negatively, while controlling for age and gender.

A hierarchical multiple regression was performed to investigate the association of mindfulness (MAAS) with rumination, after controlling for age and gender. In the first step of the model, age and gender were entered. This model was not statistically significant as $F(2, 242) = 2.16$; $p = .11$. After entry of mindfulness in Step 2 the total variance explained by the model as a whole was 24% ($F(3, 241) = 25.29$; $p <.001$) (See Table 9).

A second hierarchical multiple regression was performed to investigate the association of mindfulness (Non-judge) with rumination, after controlling for age and gender.

In the first step of the model, age, and gender were entered. This model was not statistically significant. After entry of mindfulness in Step 2 the total variance in the outcome variable. MAAS negatively predicted self-rated rumination [$t(1,248) = -5.4$,explained by the model as a whole was 24% ($F(3, 241) = 22.88$; $p < .001$) (see Table 10).

These findings are in line with the hypothesis that individuals who rated themselves highly on mindfulness tend to see themselves as less ruminative.

A third hierarchical multiple regression was performed to investigate the association of mindfulness (Describing) with rumination, after controlling for age and gender. In the first step of the model, age and gender were entered. This part of the model was not significant. After entry of mindfulness in Step 2 the total variance explained by the model as a whole was 5.8% ($F(3, 241) = 4.96$; $p < .01$). These findings are in line with the hypothesis that individuals who rated themselves highly on the describe dimension would also tend to see themselves as less ruminative (see Table 11).

Hypothesis IV. Three hierarchical regressions were run using the SPSS 23 statistical package to examine whether non-judging and describing predicted rumination following an experience of recalling an emotionally relevant event, while controlling for age and sex, among 54 participants. Contrary to prediction, none of the predictors accounted for significant variance in self-rated rumination.

Hypothesis V. To address the question of whether a multivariate relationship exists between mindfulness skills and alexithymia, a 6x3 canonical correlation was conducted using the SAS 9.4 statistical package. Canonical variables included the MAAS and the five subscales of the FFMQ. The outcome variables included the three sub-scales of the TAS-20, composed of difficulty describing feelings, difficulty identifying feelings, and externally-oriented thinking. Table 12 presents part of the correlation matrix from which the canonical roots were generated. All mindfulness self-rating indicators, with the exception of observe, were moderately to strongly negatively correlated with alexithymia dimensions. Table 13 shows the canonical functions that were generated. Two canonical functions were reported to be significant (p<.01). Table 13 shows the canonical loadings of those functions.

The standardized and squared structure coefficients pertaining to the first canonical function of mindfulness variables, which accounted for 59% of the variance of the corresponding linear combination of alexithymia outcome variables, revealed that three mindfulness canonical variables were meaningfully correlated with the first canonical variant, namely mindful and nonjudgmental awareness of experience (MAAS; r^2 = .50), Non-judge, or accepting one's experience without judgment (r^2 = .42), and Describe, or the tendency to put one's experience into words (r^2 = .72). From the Difficulties in Emotional Regulation outcome variable set, Difficulty Identifying Feelings (r^2 = -.90), and Difficulty Describing Feelings (r^2 = -.60), were meaningfully negatively associated with the canonical variant. The redundancy analysis was also carried out, and resulted in a pattern consistent with the matrices of canonical coefficients and correlations (see Table 14). According to the redundancy analysis, the first canonical variate taken together accounted for 54% of the standardized variance in the outcome variables. The canonical variable describing accounted to the greatest amount of variance (43%) in the outcome variables as a group, followed by MAAS (30%) and non-judging (25%).

The second canonical correlation, which accounted for 26% of the variance in the corresponding linear combination of alexithymia outcome variables, revealed that two mindfulness canonical variables were meaningfully correlated with the second canonical variant, namely the FFMQ dimensions of Non-Judge (r^2 = .34) and Describe (r^2 = -.16). From the alexithymia outcome variable set, Difficulty Describing Feelings (r^2 = .26) and Externally Oriented Thinking (r^2 = .24) were meaningfully correlated with the second variant. This analysis suggested that students who rated themselves highly on the ability to accept their experience non-judgmentally and had low scores on the ability to describe their experience also achieved high scores on externally oriented thinking and difficulties describing their emotions. A redundancy analysis was carried out. According to the redundancy analysis, the second canonical variate taken together accounted for 28% of the standardized variance in the outcome variables. The canonical variable describing accounted to the greatest amount of variance (47%) in the outcome variables as a group, followed by nonjudging of inner experience (33%) and MAAS (30%).

The third canonical correlation of mindfulness predictor variables and alexithymia outcome variables ($F(6,242)=1.91$, $p=.08$) was not significant, therefore it was not interpreted.

Discussion

The current study examined the associations among self-reported mindfulness and variables associated with emotional regulation, such as depression, anxiety, and awareness of emotions and the ability to describe them. As expected, the analyses for the first hypothesis established that higher self-ratings of mindfulness tend to be associated with lower risks of anxiety and depression, regardless of gender, previous psychiatric diagnosis status, or age. Lower risk of anxiety and depression was associated with nearly all aspects of mindfulness assessed, including the ability to experience one’s thoughts, sensations, and emotions as they occur with acceptance, without examining in depth or ruminating, the tendency to put behavioral and environmental events into words, and the tendency to experience completely the activities of the current moment without entering 'automatic pilot' mode. The tendency to mindfully observe, or to pay attention to current events or sensations, such as noticing how foods and drinks affect one's emotions or being aware of the sensation of the wind blowing on one's face while walking, showed no association with either anxiety or depression symptoms. This finding is consistent with past research on separate dimensions of mindfulness, where an association between observe and maladaptive psychological symptoms was found (Baer et al., 1996). It has been put forth that individuals who are alert to their own feelings and sensations may be more mindful, but they may also be acutely alert to their emotions and sensations because they are prone to mood swings and intense sensations associated with substance abuse, which may reflect maladaptive coping rather than mindful abilities (Grossman & Van Dam, 2011).

Furthermore, the current study found that mindful individuals are less likely to ruminate, or to reflect anxiously or gloomily on their emotions. Specifically, the mindful ability to accept one's inner experience without commentary or criticism, as well as the tendency to put one's thoughts and emotional experiences into words, was negatively associated with rumination, which refers to focused attention on the symptoms of one's distress (with its possible causes and consequences), as opposed to planning and finding solutions.

These results are further developed in the analyses for hypotheses II and V, which sought to achieve a better understanding of what combination of mindful skills would help individuals be more resilient when dealing with emotionally distressing issues. As expected, mindful awareness was strongly and negatively related to difficulties with emotional regulation. Specifically, individuals both mindful and accepting of their experiences who were also able to articulate these experiences were much less prone to report difficulties with non-acceptance of emotional responses and lack of access to emotion regulation strategies. They were also less likely to report alexithymic tendencies, or difficulties with identifying and describing feelings.

These findings suggest that to become resilient and cope with emotionally trying situations without becoming depressed, individuals need to accept their emotions, thoughts, and experiences without criticizing and blaming themselves. It seems that although accepting one's experience non-judgmentally is needed for self-understanding, individuals also need to express these experiences through words. In addition, individuals scoring highly on the same combination of mindfulness dimensions, namely non-judgmental awareness and tendency to describe one's experience, were particularly less likely to report alexithymia, which is an inability to recognize emotions and their subtleties. Interestingly, an independent linear combination showed that even individuals who accepted their experiences non-judgmentally, but did not see themselves as particularly skilled in articulating these experiences, tended to report somewhat higher scores on the externally-oriented thinking dimension of alexithymia. Taken together, these findings suggest that non-judgment and the tendency to talk about one's inner experience are both particularly significant pre-requisites for emotional awareness and the ability to proactively and flexibly cope with emotional distress. Mindfulness-based interventions specifically geared towards improving emotional resiliency, such as MBCT, should put emphasis on the development and pre-post assessment of non-judgmental awareness of the present experience as well as the describing of inner experience.

Contrary to prediction, the same analyses performed on the smaller sample of 54 participants who completed the rumination measure following a task while describing a recurring stressful issue in their life, yielded no association between self-rated mindfulness and rumination. Though power analyses had suggested that a sample size of 50 was sufficient, perhaps other sources of error or self-report bias contributed to obscuring this relation. It may be that an individual's self-rating on a global measure of mindfulness, such as the Mindful Awareness and Attention Scale, was simply unrelated to how ruminative that individual saw himself or herself soon after recalling a specific event.

Some limitations need to be addressed. The current study, though characterized by a large sample, was mostly composed of college-age female participants. Although mindfulness predicted emotional regulation independent of gender, future research is needed to establish if these results can be generalized to other populations. The current findings build on previous research by examining multivariate relations among mindfulness and emotional resiliency, which has implications for the future development of mindfulness-based therapies and interventions, but the assessment of self-regulation and mindfulness skills through a long battery of self-report measures taken all at one time is subjective and prone to self-report bias as well as unanticipated sources of error, such as participants' fluctuating attention while completing scales. In addition, as all measures were administered at one point in time, no causality could be established among variables, though mindfulness research operates on the implied assumption that the development of mindful skills will lead to improved emotional resiliency and lowered anxiety and depression over time. Finally, participants' self-assessment of complex skills such as awareness of present sensations hinges on their interpretation of the meaning of the items and the type of experiences they recall as they complete them, aspects of which the researcher has no knowledge. The participants' understanding of the measures might be quite different from the researcher's. Future studies should emphasize controlling for these sources of bias.

In summary, the present study suggests that the experience of mindfulness in daily life is associated with greater emotional resiliency. The findings particularly suggest that the mindful skills of non-judgmentally noticing one's present sensations, emotions, and thoughts as they unfold and being able to describe them are associated with more effective self-regulation of emotion. Individuals who can represent their own inner experience through language are more likely to acknowledge and understand their inner emotional experience instead of focusing on the external. These findings have implications for the development of mindfulness interventions.

Table 1.

Descriptives for main outcome variables.

Variable	Mean	SD	Range	Skewness	Kurtosis
MAAS	55.54	11.80	17-86	-.16	.31
Aware	25.46	5.69	8-39	-.40	.34
Describe	26.50	6.37	8-40	-.17	-.21
Non-Judge	26.59	6.60	8-40	-.18	-.39
Non-React	20.32	4.33	9-35	-.03	.09
Observe	24.72	6.27	8-40	-.07	-.29
BDI-13	6.19	5.76	0-26	1.28	1.25
DERS_Impulse	13.87	2.28	7-21	.29	.28
DERS_Goals	10.84	2.38	6-18	.53	.31
DERS_Aware	17.63	3.44	8-25	-.68	.00
DERS_Non-accept	13.09	5.05	6-30	.76	-.02
DERS_Strategies	14.73	3.24	8-25	.63	.23
Rumination	41.09	6.7	22-56	-.27	-.26
STAI-Y1	43.28	13.54	21-72	.38	-.35
STAI-Y2	44.59	11.76	21-74	.30	-.47
TAS_DIF	15.16	5.79	7-34	.62	-.18
TAS_DDF	14.03	3.11	7-23	.21	-.79
TAS_EOT	19.01	4.39	8-30	-.02	-.20

Note. *N*=251; DERS = Difficulties with Emotional Regulation Strategies; DERS_Aware: Lack of emotional awareness; DERS_Non-Accept: Nonacceptance of emotional responses; DERS_strategies: Limited access to emotion regulation strategies. STAI_Y1 = State Anxiety; STAI_Y2 = Trait Anxiety; BDI-13 = Beck Depression Inventory (Short Form).

Table 2. *Hierarchical regression of depression on mindfulness with control for psychiatric diagnoses.*

	R	R^2	R^2 *Change*	*B*	*SE*	β	*t*
Step 1	.32	.10		--	--	--	--
Psychiatric Diagnoses	--	--		5.21	.98	.32***	5.33
Step 2	.44	.30	.20***	--	4.79	--	--
Psychiatric Diagnoses	--	--	--	3.82	4.96	.24***	4.34
Mindfulness (MAAS)	--	--	--	-.22	.03	-.45***	-8.29

*p<.05; **p<.01; ***p<.001; Outcome variable: Beck Depression Inventory (BDI) depression

Table 3.

Hierarchical regression of state anxiety on mindfulness with control for gender.

	R	***R^2***	***R^2 Change***	***B***	***SE***	**β**	***t***
Step 1	.14*	.02*		--	--	--	
Gender	--	--	--	4.12	1.81	.14	2.28
Step 2	.44***	.19***	.17***	--		--	
Gender	--	--	--	1.83	1.68	.06	1.09
Mindfulness (MAAS)	--	--	--	-.42	.06	-.42***	-7.17

*p<.05; **p<.01; ***p<.001; Outcome variable: State Trait Anxiety Inventory (STAI) trait anxiety.

Table 4.

Hierarchical regression of state anxiety on mindfulness with control for age.

	R	R^2	R^2 Change	*B*	*SE*	Β	*t*
Step 1	.01	.00	.00	--	--	--	--
Age	--	--	--	.02	.19	.00	.10
Step 2	.35**	.12**	.12**	--	--	--	--
Age	--	--	--	.17	.18	.06	.94
Describe (FFMQ)	--	--	--	-.66	.11	-.36**	-5.8

*p<.05; **p<.01; ***p<.001; Outcome variable: State Trait Anxiety Inventory (STAI) trait anxiety

Table 5. *Pearson product-moment correlations of mindfulness measures and emotional regulation dimensions*

Outcome Variables	Mindfulness Canonical Variables					
	MAAS	Describe	Observe	Non-Judge	Non-React	Aware
DERS_Aware	-.34**	-.51**	-.33**	-.09	-.30**	-.26**
DERS_Non_Accept	-.36**	-.32**	-.32**	-.63**	-.33**	-.33**
DERS_Strategies	-.45**	-.37**	-.04	-.55**	-.47**	-.44**

Note. *$p < .05$. **$p < .01$. N= 251; DERS = Difficulties with Emotional Regulation Strategies; DERS_Aware: Lack of emotional awareness; DERS_Non-Accept: Nonacceptance of emotional responses; DERS_strategies: Limited access to emotional regulation strategies

Table 6.

Results of canonical correlations

Canonical variate	Eigenvalue	F	df (num.)	df (den.)	Squared canonical correlation	Sig. of F test
1	1.34	20.55	18	687.79	.57	<.001
2	.36	9.81	10	488	.26	<.001
3	.05	3.49	4	245	.05	<.01

Table 7.

Canonical solution for three functions: relations between mindfulness scales and subscales and emotional dysregulation subscales.

Variable	Canonical loadings					
	Function 1		Function 2		Function 3	
Canonical variables	Standardized coefficients	Structure coefficients (squared)	Standardized coefficients	Structure coefficients (squared)	Standardized coefficients	Structure coefficients (squared)
MAAS	.19	.45	.16	.04	-.09	.04
Non-judge	.56	.61	-.75	-.29	-.49	-.05
Describe	.29	.45	.54	.30	-.68	-.10
Aware	.01	.37	.12	.01	.69	.14
Non-react	.34	.42	-.06	.04	.75	.30
Observe	.05	.02	.41	.37	-.14	-.01
Outcome variables						
DERS_A	-.34	-.26	-.90	-.65	.32	.07
DERS_N	-.42	-.67	.61	.19	1.09	.12
DERS_S	-.54	-.77	-.06	-.07	-1.22	-.19

N = 251; Difficulties with Emotional Regulation Strategies = DERS; DERS_A = Lack of emotional awareness; DERS_N = Nonacceptance of emotional responses; DERS_S = Limited access to emotional regulation strategies.

Table 8.

Canonical redundancy analysis

Variable Canonical variables	Function 1 Squared multiple correlations	Function 2 Squared multiple correlations	Function 3 Squared multiple correlations
MAAS	.26	.27	.28
Non-judge	.34	.47	.43
Describe	.25	.34	.35
Aware	.21	.22	.23
Non-react	.25	.25	.27
Observe	.01	.11	.12
Outcome variables			
DERS_A	.15	.33	.33
DERS_N	.39	.44	.45
DERS_S	.44	.45	.46

Note. MAAS = Mindful Attention and Awareness Scale; DERS = Difficulties with Emotional Regulation Strategies.

Table 9.

Hierarchical regression of rumination on mindfulness (MAAS), controlling for age and gender.

	R	***R^2***	***R^2 Change***	***B***	***SE***	**β**	***t***
Step 1	.13	.02		--	--	--	--
Age	--	--	--	.00	.11	.00	-.04
Gender	--	--	--	2.15	1.04	.13*	2.07
Step 2	.49***	.24***	.22***	--	--	--	--
Age	--	--	--	.04	.10	.02	.44
Gender	--	--	--	.65	.70	.04	.70
MAAS	--	--	--	-.27	.03	-.48***	-8.39

Note. *p<.05; **p<.01; ***p<.001; Outcome variable: rumination

Table 10.

Hierarchical regression of rumination on non-judgment, controlling for age and gender.

	R	R^2	R^2 ***Change***	***B***	***SE***	**β**	***t***
Step 1	.13	.02		--	--	--	--
Age	--	--	--	.00	.11	.00	-.04
Gender	--	--	--	2.15	1.04	.13*	2.07
Step 2	.47***	.22***	.22***	--	--	--	--
Age	--	--	--	.04	.10	.02	.44
Gender	--	--	--	.65	.70	.04	.70
Non-Judge	--	--	--	-.46	.06	-.46***	-7.95

Note. *p<.05; **p<.01; ***p<.001; Outcome variable: rumination

Table 11.

Hierarchical regression of rumination on describing, controlling for age and gender.

	R	***R²***	***R² Change***	***B***	***SE***	**β**	***t***
Step 1	.13	.02		--	--	--	--
Age	--	--	--	.00	.11	.00	-.04
Gender	--	--	--	2.15	1.04	.13*	2.07
Step 2	.21**	.58**	.04**	--	--	--	--
Age	--	--	--	.05	.11	.02	.45
Gender	--	--	--	1.88	1.02	.04	1.83
Describe	--	--	--	-.22	.07	-.20**	-3.22

Note. *p<.05; **p<.01; ***p<.001; Outcome variable: rumination

Table 12

Pearson product-moment correlations of mindfulness measures and The Alexithymia Scale (TAS-20) dimensions

TAS-20 Outcome	Mindfulness Canonical Variables					
Variables	MAAS	Describe	Observe	Non-Judge	Non-React	Aware
TAS_DIF	-.54**	-.58**	-.00	-.55**	-.36**	-.46**
TAS_DDF	-.39**	-.58**	-.01	-.29**	-.14*	-.35**
TAS_EOT	-.24**	-.40**	-.19**	.05	-.13*	-.19**
DERS_Strategies	-.45**	-.37**	-.04	-.55**	-.47**	-.44**

Note. **p* < .05. ***p* < .01. *N*= 251; TAS_DIF= Difficulty identifying feelings; TAS_DDF = Difficulty describing feelings; TAS_EOT = Externally-oriented thinking.

Table 13.

Results of canonical correlations for Hypothesis V

Canonical variate	Eigenvalue	F	df (num.)	df (den.)	Squared canonical correlation	Sig. of F test
1	1.47	15.10	24	694	.59	<.001
2	.31	5.86	14	480	.24	<.001
3	.05	1.91	6	241	.04	0.08

Table 14.

Canonical solution for the first and second function: relations between mindfulness scales and subscales and alexithymia subscales.

Variable	Canonical loadings			
	Function 1		Function 2	
Canonical variables	Standardized coefficients	Structure coefficients (squared)	Standardized coefficients	Structure coefficients (squared)
MAAS_total	.31	.50	-.09	.00
Non-judge	.37	.42	.74	.34
Describe	.66	.72	-.53	-.16
Aware	-.07	-.38	-.24	-.05
Non-react	.04	.18	.37	.03
Observe	-.12	.00	-.19	-.10
Outcome variables				
TAS_DIF	-.75	-.90	-.71	-.06
TAS_DDF	-.33	-.60	.51	.26
TAS_EOT	-.07	-.12	.80	.24

Note. TAS_DIF= Difficulty identifying feelings; TAS_DDF = Difficulty describing feelings;

TAS_EOT = Externally-oriented thinking.

Table 15.

Canonical redundancy analysis

Variable Canonical variables	Function 1 Squared multiple correlations	Function 2 Squared multiple correlations	Function 3 Squared multiple correlations
MAAS	.30	.30	.31
Non-judge	.25	.33	.33
Describe	.43	.47	.47
Aware	.23	.23	.23
Non-react	.10	.11	.14
Observe	.00	.03	.04
Outcome variables			
TAS_DIF	.54	.55	.56
TAS_DDF	.36	.39	.40
TAS_EOT	.07	.23	.24

TAS_DIF= Difficulty identifying feelings; TAS_DDF = Difficulty describing feelings;

TAS_EOT = Externally-oriented thinking.

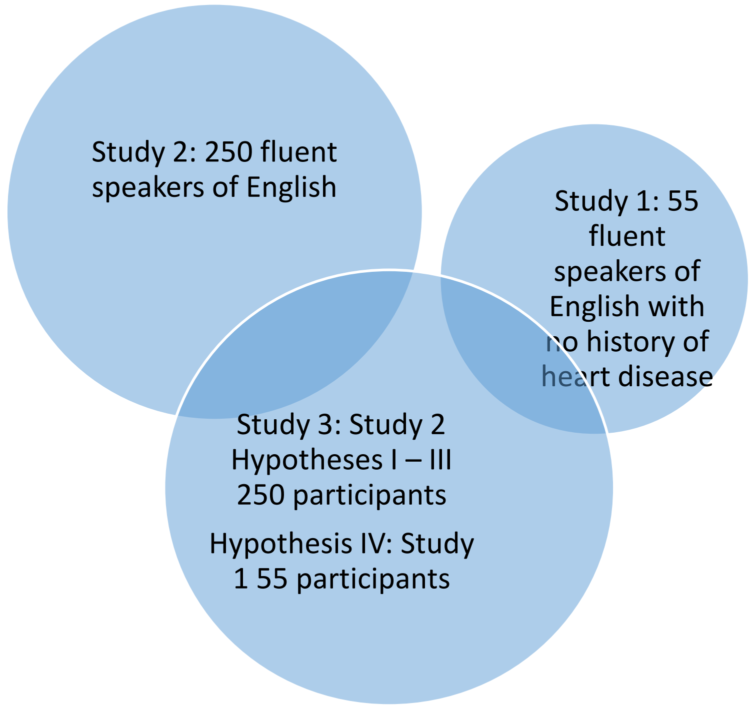
Study 2: 250 fluent speakers of English
Study 1: 55 fluent speakers of English with no history of heart disease
Study 3: Study 2 Hypotheses I – III 250 participants
Hypothesis IV: Study 1 55 participants

Figure 1. Diagram representing participants for all studies.

Step 1

Age → Rumination (subscale of RRQ)

Step 2

Sex → Rumination

Step 3

Non-Judge* → Rumination

Sex

Age

(no interaction between mindfulness and age or sex is expected)

*Two other regression analyses will include the observe subscale of the FFMQ and the MAAS as predictors.

Figure 2. Hypothesis III and IV hierarchical regression analyses.

Data collection Phase I (250 participants):

Study 2 Hypotheses I and II and all of Study 3 hypotheses.

250 participants, assessed in groups 20-30 participants to write:

Mindfulness measures (MAAS, Mindfulness History Form, FFMQ), and

Study 2 measures: Beck Depression Inventory (BDI), the State-Trait Inventory – Form Y (STAI), the Difficulties in Emotion Regulation Scale (DERS), the Rumination Reflection Questionnaire (RRQ) (expected to take 45 minutes); and

Study 3 measures: including the Perceived Stress Scale – 10 (PSS-10); The Academic Coping Strategies Scale (ACSS); the Social Provisions Scale (SPS), The Big Five Inventory (BFI-10), and the College Academic Self-Efficacy Scale (CASES).

Data collection Phase II: (55 participants separate from Phase I):

Study 1 and Hypothesis IV for Study 2. Data collection relevant to Study 3 hypothesis IV highlighted in green.

Session I

Mindfulness Questionnaires → Mindful Breathing Exercise → Toronto Mindfulness Scale ACSS; CASES

(collection of data on level of engagement with MBE)

Session II

Initial Baseline → Autobiographical Recall Stress Task → Calming Phase →

Mindful Breathing Exercise → Recovery Baseline → Rumination questionnaire RRQ; Coding and Animal Fluency

→ Debriefing

Figure 3. Study data collection procedures.

Session I

Mindfulness Questionnaires → Mindful Breathing Exercise → Toronto Mindfulness
(collection of data on level of engagement with MBE)

Session II

Initial Baseline Stress Task → Autobiographical Recall → Calming Phase →

Mindful Breathing Exercise → Recovery Baseline → Debriefing

Figure 4. Order of study procedures. Physiological data collection phases are highlighted in yellow.

CHAPTER 4

Mindfulness, Self-Appraisal, and Academic Coping Skills

For young adults, post-secondary education can be a stressful experience. The demands of academic workload, financial challenges, and being away from home may tax psychological resources and negatively impact the health and well-being of students. In recent years, the increase in mental health issues on college and university campuses has motivated growing interest in therapeutic interventions that include life-skills, such as mindfulness meditation. Mindfulness, which has been commonly defined as the “state of being attentive to and aware of what is taking place in the present” (Bishop, 2004), or as a purposeful, non-judgmental attention to moment-by-moment experience, is broadly associated with effective coping (Weinstein, Brown, & Ryan, 2009). Yet little is known about how mindfulness is related to the ability to cope with specific challenges. It is the aim of this chapter to discuss how mindfulness skills may be associated with coping through effective appraisals of the environment and the self. Background theories of stress and coping will be introduced. The influence of mindfulness on the perception of threat will be discussed, with emphasis on primary and secondary appraisals. In particular, the associations between mindfulness and effective coping through social support and academic self-efficacy will be addressed. Finally, how secondary appraisals of coping, particularly perceived social support, academic self-efficacy, and approach coping, may mediate the relation between mindfulness and perceived stress, will be explained.

Perceived Stress and Mindfulness

According to Lazarus and Folkman's (1984) *cognitive-transactional stress theory,* stress results when the individual relates to the environment in such a way that demands of the situation exceed the person's ability to cope. Stress unfolds within a specific context. Whether a person judges a particular interaction as stressful is determined by the individual's personal qualities, such as values, attitudes, and temperamental characteristics, as well as by the environment, which may be interpreted as threatening or challenging by the person (Lazarus & Folkman, 1984). Initially, the individual evaluates the significance of a stressor or threatening event – a process referred to as 'primary appraisal.' Neuroticism, a tendency to be highly susceptible to unpleasant emotions, has been linked to greater frequency and intensity of experienced problems (Watson & Pennebaker, 1989), which suggests that neurotic individuals are more likely to assess any situation as threatening. For example, they might become distressed by an upcoming competition, whereas another person might see it as a welcome challenge. Another characteristic of personality, openness-to-experience, may be hypothesized to associate negatively with perceived stress. Openness-to-experience, conceptualized as a stable personality dimension by the Five Factor Model (FFM; Costa & McRae, 1992), reflects the degree of intellectual curiosity, creativity and preference for novelty and variety that a person has. It is negatively associated with negative affect and positively associated with positive affect. This daring attitude and preference for novelty would seem to be negatively associated with the tendency to perceive threat in the environment. In this way, personal characteristics influence the primary appraisal of the environment.

Recent research suggests that individuals with well-developed mindfulness skills do not seem to experience daily events as threatening to the degree that others do (Palmer &

Rodger, 2009; Weinstein, Brown, & Ryan, 2009). Mindfulness has been defined as the individual being aware of and alert to their physical sensations, emotions, and thoughts (Kabat-Zinn, 2003). The mindful state is supported by a constant self-regulation of attention, as individuals' wandering thoughts are continuously returned to the present sensation of the breath. All aspects of experience are noticed without being examined in depth or ruminated upon. Though typically defined as a state, mindfulness may also exist as a trait-like tendency within individuals, referred to as 'dispositional mindfulness'. According to Cohen, Kamarck, and Melmelstein (1983), events are only as stressful as we interpret them to be, and we may interpret them to be negative or excessively demanding. Perhaps the mindful tendency to return to the present moment without giving excessive attention to the interpretation of events reduces the perception of daily events as stressful. However, it must be kept in mind that any association between mindfulness and perceptions of stress may be partially explained by related pre-existing stable personality characteristics, such as low neuroticism or elevated openness-to-experience, which are related to perceived stress or negative affect, as mentioned earlier. Openness-to-experience has shown modest but significant correlations with mindfulness (Brown & Ryan, 2003). Since one of the qualities of mindful attention is to maintain an attitude of curiosity and openness-to-experience (Bishop, 2004), an association with openness-to-experience is not surprising. Mindfulness has also shown moderate negative correlations with neuroticism (Brown & Ryan, 2003).

Secondary Appraisals of Stress and Mindfulness

Lazarus and Folkman (1984) suggest that appraisal does not end with the primary experience of the stressor. Once the individual has recognized a negative event as a threat, the next step is to appraise the resources available for dealing with the stressor (Lazarus &

Folkman, 1984). This is known as ‘secondary appraisal.’ Lazarus and Folkman (Folkman, Lazarus, Gruen, & DeLongis, 1986; Lazarus, 1999; Lazarus & Folkman, 1984) suggest that secondary appraisal has two components. One concerns the level of social support one has from others. The other concerns the specific coping strategies available to the individual, such as positive reframing, humour, spirituality, or blaming one-self for negative outcomes.

The link between social support and mental health outcomes is well-established. Social support is believed to act as a ‘stress buffer’, reducing the effects of stressful life events on health, due to supportive actions of others (enacted support) or the belief that support is available (perceived support; Lakey & Cohen, 2000). Specifically, perceived support, or the level and quality of support that individuals perceive as available to them right now, is linked to mental health outcomes (Lakey & Orehek, 2011). Individuals are also less likely to appraise stressful environmental events as unmanageable threats to well-being. Individuals with greater perceived support are more likely to spend quality time with others, participating in conversation and shared activities and interests. It is believed that such interactions enhance well-being through regulation of mood. Hence, individuals with high perceived support are better equipped to cope with stressful events when they occur. In fact, low levels of perceived support have been associated with higher levels of stress and clinical depression, while high perceived support has been associated with happiness (Lakey & Cronin, 2008). It is reasonable to conclude that if the capacity for perceiving and receiving social support could be enhanced, benefits for mental health would be observed. To a large degree, perceived support is viewed as a stable quality, based largely on one’s history of receiving effective enacted support (Lakey & Orehek, 2011). However, the way individuals perceive social support is also acutely subjective and dependent on interpretation of interpersonal feedback (Lakey & Cassidy, 1990). For instance, a simple incident like a friend's failure to return a phone call could be interpreted as a sign of rejection, or reframed to mean that the friend is simply busy that day. Individuals with low perceptions of social support are more likely to interpret such an incident as rejection because they display a negative bias in their memory of supportive behaviors, tend to evaluate novel supportive behaviours as unhelpful, and have negative expectations for their relationships with others. These biases affect the interpretation of interpersonal feedback (Lakey & Cassidy, 1990). Hence, perceived support is a cognitive variable representing a system of beliefs that are prone to bias.

Mindfulness practice is relevant to perceptions of social support because it is believed to reduce negative distortions. Mindful open awareness has been described as a 'pre-reflexive' state where a person's attachment to pre-existing schemas is reduced and attentional resources are diverted from unhelpful dwelling on negative meanings to focus on the experience at hand (Farb et al., 2012; Teasdale et al., 2002). When attention is anchored to a purposeful physical process, such as breathing, the tendency to dwell on negative interpretations is reduced. Attention is brought back non-judgmentally and with purpose each time individuals re-focus on their breathing following the experience of recognizing their attention has wandered. Because they do not dwell on processing negative information, mindful individuals may be better equipped to focus on the present and recognize available opportunities (Bishop, 2004; Shapiro et al., 2006). These opportunities may include possibilities for amicable interaction, friendship and social support. In addition, because of their ability to let go of negative emotions, mindful individuals may be less likely to interpret the behaviour of others as rejection. In support of this hypothesis, previous findings about the benefits of mindfulness include greater connectedness with others. In one study, undergraduate participants showed increased feelings of social connection and positivity towards strangers after just a few minutes of loving-kindness meditation (Hutcherson, Seppala, & Gross, 2008). However, although past findings suggest that momentary mindfulness induction can lead to a short-term boost in pro-social emotions and behaviors, little is known about how dispositional mindfulness may influence feelings of connectedness to others in day to day life.

The effect of mindfulness on coping through social support among university students is a promising area to explore, but this must be done with attention to methodological issues. In the past, research on coping has tended to assess coping skills through a variety of broad self-report measures asking participants to rate what strategies they rely on when faced with any kind of stressor in general (Folkman & Moskowitz, 2004). Such an approach is unlikely to adequately reflect participants' coping skills because coping is dependent on context. Specific strategies, such as drawing on the support of others, are only as effective as their fit within an individual's goals in a specific situation, a situation that is appraised as personally significant and as taxing or exceeding the individual's resources (Lazarus & Folkman, 1984). Among the undergraduate population, the influence of social support is especially relevant within the area of academic coping (Sullivan, 2010).

Mindfulness, Social Support, and Academic Coping

Understanding how students adjust to academic demands is important, because stress can negatively impact academic performance and motivation. Typical stressors experienced by students include financial difficulties, fear of failure, and excessive worry about not being able to pass a course or succeed with a course requirement (Pritchard & Wilson, 2003). The better students are at self-regulating negative emotions and managing initial setbacks, the more energy they can invest into effective methods of study and academic performance (Devenport & Lane, 2006; Howell & Buro, 2011). Coping with academic setbacks can be accomplished through a variety of strategies. According to work by Sullivan (2010) academic coping is comprised of three factors: approach coping, avoidant coping, and social support. Approach coping, which refers to active and direct responses to stressors in an attempt to change them, includes strategies such as planning, trying to think of the problem in a positive way, and using humor to cope with the problem. Students who employ approach coping try to actively handle challenges, which has been found to reduce perceived stress (Soderstrom, Dolbier, Leiferman, & Steinhardt, 2000). Avoidant coping, which involves cognitive or behavioral attempts to escape or disengage from the stressful situation or environment, includes denial, substance abuse, and the blaming of oneself. Social support refers to seeking support from other people to help handle the problem or help deal with the stress resulting from the problem.

It is reasonable to view mindfulness as directly associated with social support and approach coping skills in an academic context, as well as negatively associated with avoidant coping. Individuals who are mindful in everyday life tend to engage in approach coping and are less likely to use avoidant strategies than other individuals (Palmer & Rodger, 2009; Weinstein, Brown. & Ryan, 2009). The practice of mindfulness is especially likely to be effective in assisting individuals as they gain balance under stress because mindful awareness is effective in alleviating negative affect and anxiety (Roemer & Orsillo, 2002), which can cripple effective coping and lead to avoidant coping (Borkovec, Alcaine, & Behar, 2004). Mindfulness practice promotes engagement with the present moment and openness to current experience without excessive processing of potentially threatening information and self-judgment. In this way, individuals are encouraged to effectively focus on the issue and use their resources to problem-solve (Shapiro et al., 2006).

Although broad self-report measures of mindfulness and coping have shown to be associated, many questions remain unanswered. Mindfulness is a construct supported by, and closely related to, the self-regulation of attention and emotion (Bishop, 2004). Though mindfulness may correlate with coping skills, the association may be partially explained by related pre-existing stable personality characteristics, such as low neuroticism or elevated openness-to-experience, which, as previously mentioned, are related to mindfulness. Openness-to-experience, conceptualized as a stable personality dimension by the Five Factor Model (FFM; Costa & McRae, 1992), reflects the degree of intellectual curiosity, creativity and preference for novelty and variety that a person has. According to Costa and McRae, those high on this dimension actively seek experience and tolerate and actively explore the unfamiliar. Openness-to-experience has previously been shown to associate with problem-solving coping strategies such as active planning and reframing (Burgess, Irvine, & Wallymahmed, 2010). Neuroticism is understood as the tendency to experience unpleasant emotions (Costa & McRae, 1992), and neurotic individuals are more likely to assess situations as threatening. Neuroticism affects the experience of stress and may affect the coping resources that individuals have available, independently of mindfulness skills. Both openness-to-experience and neuroticism should be included as controls in analyses of the role of mindfulness skills in coping.

Additionally, although a few studies have examined the connection between specific coping skills and mindfulness, little is known about the associations between mindfulness and students' self-appraisal of personal resources, self-efficacy and competence. Perceived competence, or coping self-efficacy, is crucial in the development of adaptive academic coping, because before completing a task, such as an academic assignment, individuals assess their confidence to manage demands and meet outcomes (Devenport & Lane, 2006). Previous studies have shown that students with greater self-efficacy are more likely to use active coping strategies (Devenport et al., 2003). Self-efficacy beliefs are also associated with a stronger tendency to perceive the availability of social support (Bandura, 1993). Self-efficacy is defined as "the levels of confidence individuals have in their ability to execute a course of action or attain specific performance outcomes" (Bandura, 1997, pp. 23). It is malleable and influenced by information derived from four main sources: performance accomplishments, vicarious experiences, verbal persuasion, and the control of negative emotions (Bandura, 1997). Devenport and Lane (2006) state that academic coping self-efficacy is a complex ability dependent on the ability to manage time, use learning resources, work in groups, and communicate.

Because self-efficacy is malleable, cognitive in nature and influenced by perceptions, it is likely to be influenced by mindfulness skills. Mindfulness is associated with reduced attachment to pre-existing negative schemas (Bishop, 2004; Teasdale, 2002). Mindfulness is also associated with self-acceptance and non-judgment (Kabat-Zinn, 2003). Past research suggests that the self-acceptance component of mindfulness, which facilitates individuals' acceptance that they are in a difficult situation, may influence perceptions of self-efficacy. Neff et al. (2005) hypothesized that self-compassion would be associated with improved perceptions of one's self-efficacy because lack of self-compassion is related to shame, harsh self-judgment, and lowered perceptions of self-efficacy. Self-compassion, which is described as a non-judgmental awareness of one's own suffering and an attitude of kindness and understanding towards oneself in instances of failure, is negatively correlated with fear of failure but positively correlated with perceived competence. In accordance, it is hypothesized that mindfulness, as a non-judgmental quality of awareness and poise in the face of negative events, will be positively related to self-efficacy as well as specific coping skills.

In summary, mindfulness skills may be related to effective coping in a variety of ways for undergraduate students. Mindful students are likely to experience challenging situations as less threatening and to perceive their own resources more favourably. Specifically, they may have more favourable perceptions of social support available to them and may have greater confidence in their own competence for problem-solving. Mindfulness skills are likely to be associated with coping skills independently of stable personality traits such as neuroticism and openness-to-experience. Hence, mindfulness skills are likely to be associated with lower perceived stress directly as well as indirectly through enhancing secondary appraisals of coping. The subsequent section will explain the function of secondary appraisals as mediators between mindfulness skills and perceived stress.

Self-Efficacy and Academic Coping as Mediators of the Effect of Mindfulness on Perceived Stress

Based on past literature, mindfulness skills are associated with reduced perceived stress (Palmer & Rodger, 2009; Weinstein, Brown, & Ryan, 2009). The mindful tendency of remaining aware of the present moment, as opposed to dwelling on or reinterpreting past events, appears to reduce the anticipation of future stress, making the environment appear less threatening to the individual (Palmer & Rodger, 2009; Weinstein, Brown, & Ryan, 2009). However, in addition to mindfulness being directly related to the perception of stress, mindfulness may be associated with perceived stress indirectly through the intervening variables of secondary appraisal. To establish the effect of mediation, it will be necessary to first clarify the relation between the predictor, mindfulness, and the secondary appraisal mediators, as well as to demonstrate that the mediator has an effect on the outcome variable, perceived stress, while parsing out the effect of the predictor (Preacher & Hayes, 2008). The secondary appraisal variables include the perception of personal resources available for dealing with the stressor, including perception of social support, the approach factor of coping skills, and academic self-efficacy. It is the aim of this section to explain these links.

As discussed earlier in this chapter, mindful skills or tendencies influence the perception of personal resources available for dealing with environmental stress, such as perceived social support. Specifically, since social support is subjective and dependent on the interpretation of interpersonal feedback (Lakey & Cassidy, 1990), mindfulness skills can positively influence the perception that social support is available by reducing attachment to negative cognitive biases that affect interpretation of interpersonal interactions. According to past literature, the belief that others are available for instrumental and emotional support is associated with improved well-being and lower tendencies to view the environment as stressful (Lakey & Cronin, 2008). In this way, mindfulness may affect the perception of daily stress indirectly through the perception of available support.

Academic approach coping represents another potential mediator of the relation between mindfulness and perceived stress. As mentioned earlier in this chapter, mindfulness should have a direct link to enhanced approach coping. Specifically, because mindful individuals are likely to reject avoidant coping in favour of approach (Palmer & Rodger, 2009; Weinstein, Brown, & Ryan, 2009), they are also likely to engage in approach coping in the context of academics, which entails reaching out for help and actively problem-solving to overcome difficulties (Sullivan, 2010). Approach coping has been found to reduce perceived stress (Soderstrom, Dolbier, Leiferman, & Steinhardt, 2000).

Although little is known about the association of mindfulness and self-efficacy, as mentioned previously, it is likely that the mindful quality of self-compassion, or understanding towards oneself even when one has failed, is related to improved perceptions of self-efficacy (Neff, Hsieh, & Dejitterat, 2005). According to past literature, individuals with strong self-efficacy have greater confidence in their abilities to control outcomes of challenging events, which lowers their propensity to experience stress (Cheng, Lau, & Chan, 2014).

The Proposed Study

Early studies of mindfulness and coping in the general population posit that individuals with the tendency to be mindful in daily life are receptive to internal and external stimuli as they occur. Such individuals are less likely to engage in experiential avoidance (Weinstein, Brown, & Ryan, 2009), and, consequently are likely to carry out adaptive appraisals that lead to mastery of the situation (Palmer & Rodger, 2009; Weinstein, Brown, & Ryan, 2009). For example, mindfulness skills may be positively associated with the perception that social support is available, because mindful individuals are less likely to form and maintain biased, negative beliefs that affect the interpretation of interpersonal feedback (Teasdale, 2002). However, research on the intersection of mindfulness and coping has so far only addressed broad questions such as correlations between mindfulness and coping styles, using global self-ratings of mindfulness and retrospective coping. Moreover, these preliminary studies do not address the issue that pre-existing stable personality characteristics, including neuroticism or openness-to-experience, may influence the relation between mindfulness and coping. Past findings show broad associations between mindfulness and coping. For instance, preliminary findings suggest that mindfulness is positively associated with approach coping, or the ability to alleviate stress by tackling the problem directly (Palmer & Rodger, 2009; Weinstein, Brown, & Ryan, 2009). However, little is known about how mindfulness skills are associated with functioning in specific areas of life, such as academics, or how they may facilitate dealing with a specific stressor, such as a challenging exam. One possibility is that mindfulness affects students' appraisal of personal resources, or students' self-efficacy and competence. Because mindful individuals are less prone to maintain negatively biased thinking about the self, they should be more likely to avoid the harsh self-judgments known to reduce perception of self-competence. Mindful self-regulation of attention is also associated with greater allocation of attentional resources to recognize what is happening in the immediate environment (Bishop, 2004), which includes positive cues and opportunities for problem-solving. Hence, it may be expected that mindful students are better equipped for problem-solving because they are more aware of resources and possibilities available to them.

The current study aimed to address these gaps in past research to answer the following research questions: (1) How is mindfulness associated with students' perception of social support available?; (2) Is mindfulness associated with primary and secondary appraisals, while controlling for personality dimensions of neuroticism and openness-to-experience?; (3) How is the tendency to be mindful related to appraisals of coping self-efficacy in response to a specific stressor and perceptions of one's ability to cope with the academic environment?; and (4) Do academic self-efficacy, approach coping, and perceived support mediate the relation between mindfulness and perceived stress? It is important to note that as measures will be administered at one point in time, the current study aims to establish associations rather than causal relations among variables.

Research Hypotheses

The current study proposed a parsimonious model with specific predictions.

Hypothesis I. *Mindfulness and primary appraisal of threat*. It was predicted that high scores on mindfulness measures, including the Mindful Attention and Awareness Scale and the Five Facet Mindfulness Questionnaire, would be negatively associated with scores on the Perceived Stress Scale, a measure of perceived stress. It was expected that high scores on all factors of the Five Facet Mindfulness Questionnaire, including neuroticism, or the tendency to experience negative emotions, and openness-to-experience, which reflects intellectual curiosity and preference for novelty, would need to be included in the model as controls. It was expected that mindfulness skills would be associated with lower perceived stress, and that the relation will not be better explained by these stable personality variables.

Hypothesis II. *Mindfulness and perceived social support*. Perceived support is a cognitive variable representing a system of beliefs which are prone to bias (Lakey & Cassidy, 1990), and mindfulness is believed to reduce negative distortions (Bishop, 2004; Teasdale, 2002). It was predicted that participants who score highly on self-report measures of mindfulness skills will have higher self-ratings on a measure of perceived social support, while controlling for neuroticism and openness-to-experience. Specifically, it was expected that higher scores on the Mindful Awareness and Attention Scale would be associated with higher scores on the Social Provisions Scale. Factors known to be associated with perceived social support were also controlled for, including state anxiety, depression, and number of immediate and extended family members residing in the area. It is known that perceived support is related to dysphoria and anxiety (Lakey, 1990), as well as number of family members residing in the area (Cutrona, 1986).

Hypothesis III. *Mindfulness and self-appraisals of academic self-efficacy and specific academic coping skills*. It was expected that high self-ratings on mindfulness scales would be associated with high self-ratings on measures of academic self-efficacy when faced with a specific academic challenge - a difficult exam. Academic self-efficacy was represented by the three factors of the College Academic Self-Efficacy Scale. It was also expected that mindfulness skills would be associated with higher self-ratings on specific academic coping skills, while controlling for neuroticism and openness-to-experience. Academic coping skills were represented by the three factors of the *Academic Coping Strategies Scale* (ACSS). High self-rated mindfulness was expected to be associated with more adaptive self-appraisals of academic self-efficacy and more effective use of coping skills.

Hypothesis IV. It was expected that self-efficacy, approach coping, and perceived social support would mediate the relation between mindfulness skills and perceived stress. A model of the relations between mindfulness, secondary appraisal, and perceived stress is proposed (Figure 4). It was expected that mindfulness would be directly associated with reduced perception of daily stress among undergraduate students. It was also expected that this direct effect would be mediated by three indices of secondary appraisal of resources, including academic self-efficacy, approach coping, and perceived social support. It was expected that high self-ratings on mindfulness measures, specifically the MAAS, would be positively correlated with scores on the approach coping sub-scale of the Academic Coping Strategies Scale (ACSS), the overall score on the College Academic Self-Efficacy Scale

(CASES), and the score on the Social Provisions Scale (SPS), which represents perceived social support. In addition, it was expected that the mediator variables would be negatively correlated with scores on the Perceived Stress Scale (PSS). Finally, it is expected that the indirect effects of the mediating variables would explain a significant portion of the relation between mindfulness and perceived stress in daily life.

Methods

Power Analysis

To determine the number of participants needed to detect whether mindfulness is associated with perceived stress and perceived social support over and above the effect of neuroticism and openness-to-experience, literature was searched for studies using linear regression or correlation to detect the association of mindfulness and perceived stress scale. Correlational studies examining the correlation between mindfulness and perceived stress have shown moderate effect sizes (Brown & Ryan, 2003; Brown, West, Loverich, & Biegel, 2011). No studies examining the association between self-rated mindfulness and perceived social support were found. However, the power necessary for the same analysis while controlling for the effect of neuroticism and openness-to-experience is likely greater. An *a priori* power analysis was conducted with the program G*Power v. 3.1.5. (Erdfelder, Faul, & Buchner, 2007) for a linear multiple regression with six predictors, yielding 92 participants for a moderate effect size and 263 participants for a small effect size. Previous studies show low to moderate correlations between mindfulness scales and related constructs, and constructs related to coping skills among students (Rodger & Palmer, 2009; Brown & Ryan, 2003). To understand the relations between mindfulness and academic self-efficacy and coping, a canonical correlation analysis was used. For canonical correlation analysis, sample sizes of at least 10 to 20 participants per variable are recommended, given reliable measures. Based on this, a sample size of 200 participants was required.

Participants

Two hundred and fifty University of Windsor undergraduate student participants were recruited through the University of Windsor undergraduate psychology participant pool. Only students who had self-reported a fluent knowledge of English were included. There were no other exclusionary criteria. This group of participants were asked to fill out self-report measures of mindfulness, academic coping, self-efficacy, perceived stress, and social support in groups of about five to ten participants. Packets of questionnaires were handed out to participants. Data collection took place on campus. Participants were 78.4% female, with a mean age of 21.01 years ± 3.26. Participants were 43.6% Caucasian, 16.4% Asian, 10.0% Black, and 21.8% Other/Mixed.

In order to collect data on general intelligence, an independent fifty-five participants were administered the ACSS and the CASES during the familiarization session. They were also individually administered the Animal Fluency and Coding tasks at the end of the experimental session. These procedures were described in chapter 2.

Measures

Demographic information. A *Demographic and Health Questionnaire* was used to collect data about the participants' physical and mental health history and any recent caffeine use, in addition to basic information about age, gender, ethnicity, GPA, academic major, and the student's year in school.

Mindfulness measures. *The Five Factor Mindfulness Questionnaire* (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) is a five-factor self-report assessment measure created following an exploratory factor analysis, which used a combined item pool from five questionnaires measuring mindfulness as a trait or tendency in daily life. It is designed for use among populations with little to no mindfulness experience. The resulting measure has 39 items and five factors representing distinct but related dimensions: observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. Items are rated on a Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). All five factors show adequate to good internal consistency, with the following Cronbach's alpha coefficients: nonreactivity = .75, observing = .83, acting with awareness = .87, describing = .91, and non-judging = .87. The FFMQ has shown significant relationships in the predicted directions with a variety of constructs related to mindfulness (Baer et al. 2006). The Describe scale has been found to positively correlate with emotional intelligence ($r(300) = .60$, $p<0.001$) and negatively with alexithymia ($r(300) = -.68$, $p<0.001$). The Observe scale was positively correlated with openness-to-experience ($r(300) = .42$, $p<0.001$). The Non-React subscale was positively correlated with self-compassion ($r=.53$, $p<0.001$). In addition, all factors except Observe yielded moderate negative correlations with maladaptive psychological symptoms. (Surprisingly, observe showed positive correlations with psychological symptoms, including dissociation, absent-mindedness, and thought suppression; Baer et al., 2006).

The *Mindfulness Practice - History Questionnaire* (Baer, Smith, & Allen, 2004) is a questionnaire intended to be included with the 39-item FFMQ scale. Participants completed this six-item measure assessing any previous experience with meditation and other devotional practices. Participants were also asked to rate the length of time for which they may have been involved with each practice.

The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) is a 15-item measure of individual differences in the frequency of mindful states over time, using a 6-point Likert scale from 1 (almost always) to 6 (almost never). High scores were said to reflect better-developed mindfulness skills. The items tap into cognitive, emotional, sensory, and interpersonal domains. It is a single factor scale with strong internal consistency, indicated by a Cronbach alpha of .82 for the student sample of 60 and .87 for a general adult sample of 239. The test-retest reliability over a four-week period based on a sample of 60 undergraduates was also strong (r = .81; p<.001) (Brown & Ryan, 2003). As predicted, the MAAS showed small to strong correlations with several sub-scales of the Trait Meta-Mood Scale, including clarity of emotional states (r(313) = .49; p<.001), mood repair (r(313) = .37; p<.001) and attention to emotions (r(313) = .19; p< .001). The MAAS also showed a modest positive correlation with the NEO-PI openness-to-experience (r(313) =.18; p<.01), and a negative correlation with Social Anxiety (r(313)= -.36; p<.001).

Primary Stress Appraisal. *The Perceived Stress Scale-10* (PSS-10; Cohen, 1983) is the most widely used psychological instrument for measuring the perception of stress (see Appendix M). It is a measure of the degree to which situations in one's life are appraised as stressful. Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives. The psychometric properties of the 10-item PSS have been found to be superior to those of the 14-item PSS (Lee, 2012). The Cronbach's alpha was found to range from 0.74 to 0.91 for the studies reviewed. The test-retest reliability of the PSS-10 was assessed in four studies, and met the criterion of >.70 in all cases (Lee, 2012). The PSS-10 has also been found to possess good test-retest reliability for a 1-week period (Chaaya, Osman, Naassan, & Mahfoud, 2010). The PSS was also found to have moderate to large correlations with the Beck Depression Inventory (Beck, Steer, & Garbin, 1988) and State-Trait Anxiety Inventory (Spielberger, 1983).

Secondary Stress Appraisal. *The Academic Coping Strategies Scale* (ACSS) is a 34-item scale designed to assess college students' coping strategies within the context of a specific academic stressor (Sullivan, 2010). The participants were presented with the prompt: "Think about a time when you received a low grade on an important exam, significantly lower than what you usually get." Each item lists a specific behavioral or cognitive coping strategy (see Appendix N). The participants were then asked to rank how often they use this coping strategy when considering the prompt, on a Likert scale ranging from 1 (almost never) to 5 (almost always). Sullivan et al. (2010) shows that the scale yields three distinct factors, including approach, which involves dealing with problems by actively trying to solve them; avoidance, or becoming involved in cognitive or behavioral attempts to escape or disengage from the stressful situation or environment; and social support, which involves reaching out to others. All three scales showed good internal consistency, with Cronbach alpha coefficients as follows: approach = .91, avoidance = .82, and social support = .81. The test-retest reliability over 12 days was also examined, revealing high test-retest stability for social support ($r(297)=.88$, $p<.01$) and approach ($r(297)= .74$, $p<.01$), and somewhat lower test-retest stability for avoidance ($r(297)=.41$, $p<.01$). This low coefficient was attributed to inconsistent responses from three participants. The ACSS has also shown significant relationships in the predicted direction with a variety of constructs related to coping. For instance, approach coping was positively associated with academic self-efficacy ($r(297)=.22$, $p<.01$) and self-regulation ($r(297)=.22$, $p<.01$), social support was positively associated with self-regulation ($r(297)=.31$, $p<.01$), and avoidance was negatively associated with academic self-efficacy ($r(297)=.-17$, $p<.01$) and self-regulation ($r(297)=-.35$, $p<.01$).

Size of family network. Before being administered the Social Provisions Scale, participants were asked to list the number of family members who reside in the area. Specifically, participants were asked to list the number of immediate family members (parents, spouses, siblings, and children) and extended family members (grandparents, aunts, uncles, and cousins) living in the Windsor/Detroit area.

Perceived Support. *The Social Provisions Scale* (SPS; Cutrona & Russell 1987) was used to measure perceptions of social support. It is a 24-item scale composed of six domains, which reflect what individuals receive from other people as part of an interpersonal relationship. The six domains include guidance (advice or information), reliable alliance (assurance that others can be counted on in times of stress), reassurance of worth (recognition of one's competence), attachment (emotional closeness), social integration (a sense of belonging to a group of friends), and opportunity for nurturance (providing assistance to others). Higher scores reflect higher levels of perceived social support. Reliability for the scale ranges from .87 to .91 across a range of samples (Cutrona & Russell, 1987). The overall internal consistency of the scale has been reported as acceptable. In a study of approximately 100 elderly subjects, Cutrona, Russell, and Rose (1984) found the **internal consistency** of the scale across the six domains to be above .70. In a study of approximately 300 school teachers, internal consistency estimates were all above .60 (Russell, Altwater, & Van Velzen, 1984).

Measures of mood. *Beck Depression Inventory, Short Form* (BDI-SF; Beck & Beck, 1972) is a 13-item self-report inventory that measures characteristic attitudes and symptoms of depression. It is a widely used measure of current depressive symptoms often used for screening purposes. Relative to the full 21-item version, the 13-item BDI focuses on cognitive and somatic symptoms of depression, especially the cognitive symptoms, while leaving out some items that do not directly reflect core symptoms of depression, such as the feeling of being punished. It likewise leaves out items that can have multiple causes, such as sleep problems and weight loss. Pearson product-moment correlation coefficients between the BDI and the BDI-SF have ranged from 0.89 to 0.97, indicating that the short form is an acceptable substitute for the long (Beck, Rial, & Rickets, 1974). The BDI-13 demonstrates good concurrent validity with other measures of depression (Aalto, Elovainio, Kivimäki, Uutela, & Pirkola, 2012) and correlates highly with the longer versions of this inventory.

State-Trait Anxiety Inventory – Form Y (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) contains a 20-item measure of trait anxiety, the Trait Anxiety Subscale (S-Anxiety), which evaluates relatively stable aspects of “anxiety proneness”, or the tendency to frequently experience states of anxiety. Items are rated on a 4-point scale, and scores vary from a minimum of 20 to a maximum of 80. Higher scores are correlated with higher levels of anxiety. Trait anxiety has also demonstrated strong correlations with measures of anxiety sensitivity (Koszycki & Bradwejn, 2001; Zvolensky, Feldner, Eifert, & Stewart, 2001).

Academic performance. The participants’ self-reported estimated cumulative grade point average (GPA) was used to measure academic performance in the present study.

Global cognitive functioning. Semantic verbal fluency was assessed using the Animal Fluency subtest of the Category Fluency Test (Newcombe, 1969), to provide an estimate of general intellectual functioning. Although cognitive flexibility, or the ability to shift rapidly from word to word, contributes to verbal fluency performance, verbal fluency largely reflects an individual's verbal abilities (Sutin et al., 2011). Specifically, participants were asked to list as many animals as they can within a 60-second time period. Verbal fluency scores were the total number of unique animals generated within the time frame. Word perseverations and intrusions were not included in the total verbal fluency score. The test-retest reliability for the FAS fluency test, which includes the Animal Fluency subtest, has been found to be quite high (in excess of 0.70; Basso, Bornstein, & Lang, 1999).

Coding. A core Processing Speed subtest of the WAIS-IV**,** Coding requires copying symbols paired with numbers (Sattler & Ryan, 2009). The number of correct symbols within the allowed time (120 seconds) is measured for a total score. This task measures the ability to learn a novel task involving cognitive fluency and psychomotor speed. Coding is a reliable sub-test, with test-retest reliability coefficients ranging from .84 to .89. It correlates strongly with Symbol Search (r=.65), more than with any other WAIS-IV subtest (Sattler & Ryan, 2009).

Personality. *The Big Five Inventory-44* (BFI-44; John, Donahue, & Kentle, 1991) is a measure designed to capture the five dimensions of personality, and is meant to be completed in about 5 minutes (see Appendix Q). It consists of statements regarding openness, conscientiousness, extraversion, agreeableness, and neuroticism. Participants are asked to indicate, on a 5-point Likert scale (from strongly disagree to strongly agree), the degree to which each statement described their personality (John, Donahue, & Kentle, 1991). The BFI scales have shown solid internal consistency (Cronbach's alpha ranging from .79 to .88 for each of the five personality traits (*M*=.83), retest reliability, and clear factor structure, as well as substantial convergent and discriminant validity with longer Big Five measures, including the Neuroticism–Extraversion–Openness Five Factor Inventory (NEO–

FFI; *r*(280) = .73) and the Trait Descriptive Adjectives questionnaire (TDA; *r*(280) = .81; John & Srivastava, 1999).

Academic Self-Efficacy. *The College Academic Self-Efficacy Scale* (Owen & Froman, 1988) was developed to quantify students' level of academic self-efficacy, and consists of 33 items which represent typical academic behaviors on which respondents rate their degree of confidence in completing (see Appendix Q). Students rate their level of confidence on a Likert-type scale ranging from 5 points (quite a lot) to 1 point (very little). According to Owen and Froman (1988), scores for each question are summed and divided by the total number of questions. All items relate to one of the three subscales: (a) Technical Skills (e.g., using computers and library resources), (b) Social Situations (e.g., participating in a class discussion, asking a lecturer to repeat his or her explanation), and (c) Cognitive Operations (e.g., listening carefully during a lecture on a difficult topic, understanding an examination question). Higher scores indicate higher college academic self-efficacy. Owen and Froman (1988) reported a test-retest reliability coefficient at .85 with an 8-week period for a sample of 88 educational psychology students. Owen and Froman (1988) also reported internal consistency coefficients between .90 and .92 for all subscales and good empirical support for both factorial and concurrent validity. Similarly, in a sample of 215 undergraduate students, Choi (2004) reported an internal consistency coefficient of .93.

Results

Data Analysis

Data pre-processing and reduction. Prior to processing, missing data for all self-report variables were analyzed and found to be missing randomly using the IBM SPSS 23 Statistics Missing Value Analysis (MVA) procedure. Because the analysis revealed less than

5% missing data across all main dependent variables, the SPSS Estimation Maximization procedure was used to fill in missing data, for a resulting total of 249 cases.

Pre-processing of data. All main variables, including personality, mindfulness, perceived stress (PSS), perceived social support (SPS), academic coping skills (ACSS), and academic self-efficacy (CASES) were checked using the SPSS Explore command, yielding histograms and scatterplots which were visually inspected for influential outliers. Extreme outlier values were defined as numbers beyond the interquartile range (IQR), or the range encompassing the middle 50% of scores, where Q1 corresponds to the 25^{th} percentile and Q3 corresponds to the 75^{th} percentile of scores. Extreme outlier values were identified as any value lying above Q3 - 1.5*IQR or below Q1-1.5*IQR. Following elimination of extreme outliers identified by the SPSS histograms, tests of normality, including Shapiro-Wilks, were carried out. Square-root transformations were carried out for variables that were indicated to not be normally distributed. Descriptive data for all variables following transformations revealed them to be normally distributed (skewness was within +-2 and kurtosis within +- 3) and are summarized in Table 1. Analyses are addressed below and organized by hypothesis.

Determining empirical estimates of effort. Empirical estimates of effort were determined for the Chapter One participant sample, which was used to control for the effect of intelligence on academic coping. Erdodi et al. (2017) reported that a cut-off of a scaled-score ≤ 5 for Coding produced good specificity (.94- to 1.00) and low and variable specificity (0.4 to .28) in a mixed clinical sample. Kim and colleagues (2010a) reported that a ≤ 4 cut-off score was associated with acceptable specificity (.84) and good sensitivity (.57). Taken together, 3.7% of the current sample failed both the conservative ≤ 4 and liberal ≤ 5 cut-offs for Coding. For the current sample, coding scaled scores ranged from 4 to 15, with a median score of 10 (*M* = 10.48; *SD*=2.39).

Animal Fluency is a popular neuropsychological measure of verbal fluency used in the detection of invalid performance. It has often been used as an embedded validity indicator (Boone, 2013; Sugarman & Axelrod, 2015). Sugarman and Axelrod (2015) report numbers for their credible performance (*M*=18.4; *SD* = 5.3) and poor effort (*M*= 13.1; *SD*=5.7) groups. Based on the 13.1 raw score as a cut-off for Animal Fluency, 1.85% of the sample failed the cut-off. Animal Fluency raw scores ranged from 11 to 35 (*M* = 22.61; *SD*=5.82).

Main Analyses

Hypothesis Ia. The first research question focused on whether higher levels of trait mindfulness are associated with more adaptive primary appraisals of stress, while controlling for neuroticism. These analyses were conducted with correlations (see Table 2) and a hierarchical ordinary least squares (multiple) regression was calculated using the SPSS 23 statistical package. Neuroticism positively predicted perceived stress in step 1 [F (1,245) = 186.79; $p < .001$], and explained 43% of the variance in depression. Mindfulness negatively predicted perceived stress independent of neuroticism in step 2 [F (2,244) = 109.24; $p <$ .001]. The introduction of mindfulness explained an additional 4% in depression, after presence of neuroticism was controlled for (R^2 change = .04; F(1,244) = 186.78) (see Table 3).

Hypothesis Ib. To test the hypothesis that mindfulness would be negatively associated with perceived stress, even while controlling for personality variables, correlations and regressions were carried out. Bivariate correlations showed that several mindfulness variables were positively associated with openness-to-experience, but openness-to-experience was not related to perceived stress. Hence, openness-to-experience was not included in the regression.

A hierarchical regression showed that even in the presence of neuroticism, as well as the Non-judge, Aware, and Non-react dimensions [t = -3.14; p < .00], negatively predicted perceived stress. Neuroticism positively predicted perceived stress in Step 1 [F (1,245) = 186.79; p < .001] and explained 43% of the variance in perceived stress. In Step 2 [F (2,244) = 111.48; p < .001], which explained 47% of the variance in perceived stress, predictors included neuroticism and non-judgment. In Step 3 [F (3,244) = 80.64; p < .001], which explained 50% of the variance in perceived stress, predictors included non-judge, non-react, and neuroticism. In Step 4 [F (3,244) = 63.76; p < .001], which explained 51% of the variance, predictors included neuroticism, non-judge, non-react, and aware (see Table 4).

Hypothesis II. The hypothesis that mindfulness would be positively associated with global social support while controlling for personality variables, anxiety, and depression was tested. Bivariate correlations were carried out to examine the associations among mindfulness (MAAS), global social support (SPS), as well as control variables including neuroticism (BFI), openness-to-experience (BFI), trait anxiety (STAI), depression (BDI-13), and self-rated strength of family network residing in the area. Anxiety and depression were moderately negatively associated with both mindfulness and perceived social support (see Table 5). Neuroticism was also strongly negatively associated with mindfulness and weakly negatively associated with perceived social support. Openness-to-experience, number of immediate family members, and number of extended family members residing in the area were not associated with either mindfulness or global social support. A hierarchical ordinary least squares (multiple) regression was carried out to test the prediction that trait mindfulness explains variance in perceived social support based on the Social Provisions Scale, over and above neuroticism.

The regression showed that in Step 1, neuroticism negatively predicted global social support [F (1,245) = 5.04; $p < .05$] and explained 2% of the variance in global social support. In Step 2 [F (2,244) = 8.81; $p < .001$], which explained 4.7% of the variance in global social support, predictors included neuroticism and non-judgment. In Step 3 [F (3,244) = 5.03; $p < .001$], which explained 8.6% of the variance in global social support, predictors included neuroticism, STAI trait anxiety, and mindfulness (MAAS). Therefore, mindfulness negatively predicted global social support even in the presence of anxiety and neuroticism (see Table 6).

Hypothesis III. It was hypothesized that self-rated mindfulness would be positively associated with academic self-efficacy and coping skills, even while controlling for variables related to intelligence. To explore the multivariate relations between self-rated mindfulness skills and self-appraisals of academic self-efficacy, while controlling for GPA and general intelligence, a 7x3 canonical correlation was carried out using the 9.4 SAS statistical package. Canonical variables included two control variables (GPA and MAAS) and the five subscales of the FFMQ, which includes describing, observing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. The outcome variables included the cognitive, technological, and social subdomains of academic self-efficacy, represented by the College Academic Self-Efficacy Scale (CASES).

Table 7 presents part of the correlation matrix from which the canonical roots were generated. As summarized in the table, bivariate correlations showed moderate associations between mindfulness variables and academic self-efficacy, and weak to moderate correlations between GPA and self-efficacy. Table 8 shows the canonical functions that were generated. One canonical function was reported to be significant (p<.01). Table 9 shows the canonical loadings of those functions.

The standardized and squared structure coefficients pertaining to the first canonical function of mindfulness variables, which accounted for 40% of the variance in the corresponding linear combination of self-efficacy outcome variables, revealed that two mindfulness canonical variables were meaningfully correlated with the first canonical variant, namely, the ability to put one's present experience into words (describe; r^2 = .46), as well as the FFMQ dimension acting with awareness (r^2 = .49) (see Table 10). In addition, the control variable, GPA, was meaningfully correlated with the first canonical variant (r^2 = .34). From the self-efficacy outcome variable set, cognitive (r^2 = .92) and social (r^2 = .50) academic self-efficacy were particularly strongly associated with the first canonical variant (see Table 10). A redundancy analysis was also carried out, resulting in a pattern consistent with the matrices of canonical coefficients and correlations. The redundancy analysis showed acting with awareness accounted for the greatest amount of variance (19%) in the self-efficacy outcome variables as a group, followed by describing (18%), and finally GPA (13%) (see Table 11). In summary, students who reported both a strong GPA and rated themselves highly on mindful facets, particularly the ability to describe their experience and the ability to act with mindful awareness, were more likely to report confidence in their skills to master the academic material and their ability to tackle the social demands of academic work.

To address the research question of whether a multivariate relationship exists between self-rated mindfulness skills and self-appraisals of academic coping, while controlling for

GPA and general intelligence, a 7x3 canonical correlation was carried out using the 9.4 SAS statistical package. Canonical variables included a control variable, GPA, as well as MAAS and the five subscales the FFMQ, which includes describing, observing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. The outcome variables included the social support, approach, and avoidance subdomains of academic coping, represented by the Academic Coping Strategies Scale (ACSS).

Table 12 presents part of the correlation matrix from which the canonical roots were generated. As summarized in the table, bivariate correlations showed moderate associations between mindfulness variables and academic approach coping. Only the describe dimension of the FFMQ showed a moderate correlation with academic coping through social support. All mindfulness variables showed weak to moderate negative correlations with avoidant coping. Table 13 shows the canonical functions that were generated. Three canonical functions were reported to be significant ($p<.01$). Table 14 shows the canonical loadings of those functions.

The standardized and squared structure coefficients pertaining to the first canonical function of mindfulness variables, which accounted for 43% of the variance in the corresponding linear combination of academic coping outcome variables, revealed that, except for non-judging, all mindfulness canonical variables were meaningfully correlated with the first canonical variant, particularly acting with awareness (aware; $r^2 = .53$). From the academic coping outcome variable set, approach ($r^2 = .79$) and avoidant coping ($r^2 = -.76$) were meaningfully correlated with the first canonical variant (see Table 14). Hence, individuals who perceive themselves as mindful, particularly those aware of acting mindfully, are more likely to respond to stressors actively and directly, through strategies such as planning, thinking of the problem in a positive way, and using humor to cope with the problem. Such approaches have been found to reduce perceived stress. Second and third canonical functions were also identified, but both accounted for a negligible portion of the variance in the corresponding linear combination of academic coping outcome variables.

To examine the effect of general intelligence on academic coping and self-efficacy, further bivariate correlation analyses were carried out using data from 55 subjects recruited through the study in chapter two. The analyses indicated that animal fluency and coding were moderately positively correlated with each other, but were not correlated to any of the other main variables, including academic coping and self-efficacy (see Tables 16 and 17). Hence, animal fluency and coding were not included in any further analyses.

Hypothesis V. It was hypothesized that secondary appraisal variables, including perceived support, approach coping, and academic self-efficacy, would mediate the effect of mindfulness on perceived stress. The multiple mediator model with the three mediators was carried out using SPSS 22 through a macro for multiple mediation (Preacher & Hayes, 2008). The total indirect effect of the independent variable, mindfulness, on perceived stress, was -.04., as it negatively predicted perceived stress (t = -8.65, p < .00). Though mindfulness predicted all of the mediator variables, none of the mediators predicted the outcome variable, perceived stress, except for academic self-efficacy (see Figure 1). The specific indirect effects, standard errors, and critical ratios for these effects are reported in Table 18. The indirect effect of academic self-efficacy significantly predicted perceived stress. Zero is not part of the confidence interval for this indirect effect, and therefore the null hypothesis that the indirect effect is equal to the total effect is rejected. However, as shown in Figure 1, mindfulness was not strongly associated with academic self-efficacy (b weight = .03), which means that although significant, this indirect effect is not very meaningful in explaining the relation between mindfulness and perceived stress.

Discussion

The aim of this study was to address how mindfulness might play a role in students' resiliency, or ability to cope with stressful challenges. The emphasis was on exploring how mindfulness skills might be associated with reduced stress and effective appraisals of the environment and the self, with the understanding that causality between mindfulness skills and coping cannot be established within the current research design. It was hypothesized that mindful individuals would be less likely to perceive the environment as stressful or challenging and more likely to believe that they possess important resources such as academic self-efficacy, ability to cope with problems actively and directly, and ability to draw on social support to deal with life's challenges.

In support of this hypothesis, mindfulness was negatively associated with neuroticism, a personality trait often described in terms of emotional dysregulation. These results also suggest that neuroticism is negatively associated with perceived stress. This finding is consistent with past literature, as neurotic individuals are more likely to assess any situation as threatening (Watson & Pennebaker, 1989). Mindfulness was associated with lower perception of stress, independently of neuroticism. This was true for all dimensions of mindfulness except for the mindful ability to observe one's feelings, thoughts, and sensations as they come up, which was not associated directly with stress. In past literature, it was likewise found that the observe dimension was not consistently related to adaptive emotional self-regulation (Baer, Hopkins, Krietemeyer, Smith, & Toney, 2006).

Hence, mindfulness skills were directly related to diminished perceptions of stress. Further analyses suggested that mindfulness skills are associated with more positive self-assessment of personal resources available to counteract stress. Specifically, stronger self-ratings of mindfulness skills were associated with more positive perceptions of global social support available to the individual. Although generally perceived as a stable quality, global perception of social support is related to how individuals interpret interpersonal feedback, which is affected by biases such as negative expectations for relationships with others. In a state of mindful awareness, attention is drawn to the present experience, which directs focus away from negative interpretations and reduces negative distortions. Perceived support, or the level and quality of support that individuals perceive as available to them right now, is associated with greater happiness and lower stress (Lakey & Cronin, 2008).

In addition, the findings of the current study shed light on the profile of mindfulness skills that yield the greatest benefits with regards to self-efficacy and coping within the academic environment. Specifically, the tendency to focus on one's activity and the tendency to put one's experience into words were associated with confidence in one's skill as a student and the tendency to actively problem-solve, when self-reported grade point average is accounted for statistically. Self-reported mindfulness was also negatively associated with avoidant coping, or the maladaptive tendency to avoid dealing with a stressor. These findings are consistent with previous literature on how mindfulness promotes attention self-regulation. Because mindfulness practice promotes engagement with the present moment and discourages dwelling on negative thoughts and experiences, more attentional resources become available for observing opportunities and finding resources to problem-solve (Shapiro et al., 2006). These findings suggest that mindfulness training might help students become more confident in managing academic demands and reduce avoidant coping techniques like procrastination.

There are several limitations to the current study that should be considered. The assessment of mindfulness relied on self-report, which is subject to response bias. Moreover, many of the variables assessed were defined as broad categories yielding global scores, which may account for why expected relations between self-efficacy and global social support were not supported. Coping always occurs within the context of a specific stressor or situation (Lakey & Cronin, 2008), and that is why specific measures of coping, like academic self-efficacy and approach and avoidance coping within an academic context were chosen. However, the predictor and outcome variables chosen for the mediation models included global mindfulness and global perceived stress self-ratings. These global self-rating measures may not have shared variance with the more specific academic coping and self-efficacy variables, potentially explaining why the mediator models were not statistically significant. In addition, the current study relied on data collected at a single time-point, and thus causal relation between mindfulness, coping, self-efficacy, and stress could not be established. Though previous literature suggests that changes in mindfulness precede changes in attentional and emotional self-regulation (Arch & Craske, 2006), no definitive causal conclusions could be drawn due to the current study design.

Nevertheless, the current study yields findings which have important implications for student well-being and coping with stress. Future studies should focus on addressing limitations of the current research and clarifying how current findings about mindfulness and coping skills may be practically applied. For instance, subsequent research may expand on the associations between mindfulness and global social support. These dimensions may be measured longitudinally within the context of a mindfulness intervention study among undergraduate volunteers, to better understand the causal links between mindfulness and coping skills. In addition, future research may emphasize more direct measurement of important dimensions. Global social support measured through self-report, for instance, is a rather indirect method of measuring students' ability to seek support from other people. Social connectedness may be measured more directly through coded interviews or through qualitative methods, which would be less prone to self-report bias and provide more detail about individual dimensions of social support.

In summary, the results of this study indicate that mindfulness self-report was negatively associated with neuroticism and perceived stress, but positively associated with adaptive coping skills like self-efficacy, academic coping, and perceived support. Specifically, the facets of mindfulness that involve putting one's experiences into words and acting with awareness of the present moment were particularly strongly associated with academic self-efficacy and adaptive problem solving within the academic context. These findings have important implications for improving student success through training in mindfulness skills. Future studies may address important limitations, such as clarifying causality and providing more direct measurements of important constructs.

Table 1.

Descriptives for major outcome variables

Variable	Mean	SD	Range	Skewness	Kurtosis
Social_Support Coping	25.55	6.11	9.00-39.00	-.30	-.23
Approach Coping (ACSS)	55.39	8.44	22.00-75.00	-.59	.68
Avoidant Coping (ACSS)	27.26	6.77	13.00-48.00	.35	-.05
Global Support (Social Provisions Scale)	82.31	10.87	37.33-96.00	-1.05	.82
Perceived Stress Scale	20.32	6.54	4.00-40.00	-.05	-.25
Technological Self-Efficacy	1.55	.42	1.00-2.65	.30	-.58
Cognitive Self-Efficacy	4.71	1.18	1.00-7.62	-.37	.12
Social Self-Efficacy	33.58	8.39	14.00-53.00	.02	-.60
Agreeableness (Big Five)	3.89	.56	2.00-5.00	-.54	.36
Conscientiousness (Big Five)	3.65	.60	2.00-5.00	-.06	-.33
Extraversion (Big Five)	3.20	.83	1.00-5.00	-.15	-.40
Neuroticism (Big Five)	3.07	.81	1.13-5.00	.13	-.38
Openness (Big Five)	3.40	.64	1.50-4.80	-.27	-.13

Note. ACSS = The Academic Coping Strategies Scale.

Table 2.

Pearson product-moment correlations of mindfulness measures, perceived stress, and personality.

	MAAS	PSS	BFI Openness	BFI Neuroticism
MAAS	--	-.48**	.06	-.47**
PSS		--	.02	.65**
BFI Openness			--	-.01
BFI Neuroticism				--

Note. *$p < .05$. **$p < .01$. N=247. MAAS = The Mindful Attention Awareness Scale; PSS = Perceived Stress Scale; BFI = Big Five Inventory.

Table 3.

Hierarchical regression of depression on neuroticism and mindfulness.

	R	***R*²**	***R*² Change**	***B***	***SE***	**β**	***t***
Step 1	.66***	.43***	.43***				
Neuroticism				5.33	.39	.66***	13.67
Step 2	.69***	.47***	.04***				
Mindfulness (MAAS)				-.12	.03	-.23***	-4.29
Neuroticism				4.47	.43	.55***	10.50

$^*p<.05$; $^{**}p<.01$; $^{***}p<.001$; Outcome variable: BDI II depression

Table 4.

Pearson product-moment correlations of FFMQ mindfulness measures, perceived stress, and personality.

	BFI-N	BFI-O	PSS	Non-Judge	Describe	Aware	Non-react	Observe
BFI-N	--	-.01	.65**	-.49**	-.39**	-.49**	-.49	-.04
Openness		--	.03	-.08	.23**	.05	.14*	.42**
PSS			--	-.51**	-.32**	-.48**	-.44**	.01
Non-Judge				--	.26**	.43*	.21*	-.11
Describe					--	.42**	.36**	.24**
Aware						--	.31**	-.06
Non-React							--	.26**
Observe								--

*Note. *p < .05. **p < .01. N=247*; BFI-N = Big Five Inventory – Neuroticism; BFI-O = Big Five Inventory – Openness-to-Experience; PSS = Perceived Stress Scale.

Table 5.

Hierarchical regression of perceived stress on neuroticism and mindfulness.

	R	R^2	R^2 *Change*	*B*	*SE*	Β	*t*
Step 1	.66	.43	.43	--	--	--	--
Neuroticism	--	--	--	5.33	.39	.66***	13.67
Step 2	.69***	.47***	.04***	--	--	--	--
Neuroticism	--	--	--	4.32	.43	.53***	9.94
Non-Judge	--	--	--	-.24	.05	-.25***	-4.58
Step 3	.71***	.50***	.02***	--	--	--	--
Neuroticism	--	--	--	3.60	.48	.44***	7.49
Non-Judge	--	--	--	-.25	.05	-.25***	-4.83
Non-React	--	--	--	-.26	.08	-.17**	-3.22
Step 4	.72***	.51***	.01***	--	--	--	--
Neuroticism	--	--	--	.40	.49	.40***	6.55
Non-Judge	--	--	--	-.22	.05	-.22***	-4.08
Non-React	--	--	--	-.16	.08	-.16**	-2.98
Aware	--	--	--	-.14	.06	-.14**	-2.66

*p<.05; **p<.01; ***p<.001; Outcome variable: PSS_total stress

Table 6.

Hierarchical regression of global social support on mindfulness, anxiety, and neuroticism.

	R	***R²***	***R² Change***	***B***	***SE***	**Β**	***t***
Step 1	.14***	.02***	.02***	--	--	--	--
Neuroticism	--	--	--	-1.91	.85	-.14	-2.25
Step 2	.26***	.07***	.05***	--	--	--	--
Neuroticism	--	--	--	.03	1.00	.00	.03
Trait anxiety	--	--	--	-.24	.07	-.26	-3.51
Step 3	.29***	.09***	.02***	--	--	--	--
Neuroticism	--	--	--	.06	1.04	.06	.71
Trait anxiety	--	--	--	-.22**	.07**	-.22**	-2.91**
Mindfulness (MAAS)	--	--	--	.15*	.07*	.16*	2.24*

*p<.05; **p<.01; ***p<.001; Outcome variable: global social support

Table 7.

Pearson product-moment correlations of mindfulness measures, perceived stress, and personality.

	Global_SPS	MAAS	STAI_S	STAI_T	BDI_13	BFIN	BFIO	IFM	EFM
Global_SPS	--	.23**	-.25**	-.25**	-.25**	-.14*	-.04	.00	.08
MAAS		--	-.50**	-.43**	-.50**	-.47**	.06	-.04	-.02
STAI_S			--	.58**	.66**	.70**	-.00	.02	.08
STAI_T				--	.54**	-.03	-.03	.04	.10
BDI_13					--	.60**	.03	-.03	-.00
BFIN						--	-.01	.10	.09
BFIO							--	-.05	-.15*
IFM								--	.34**
EFM									--

Note. **p < .05. **p < .01. N*= 251; MAAS = The Mindful Attention Awareness Scale; STAI_S = State-Trait Anxiety Inventory – State; STAI_T = State-Trait Anxiety Inventory – Trait; BDI_13 = Beck Depression Inventory – Short Form; BFIN = Big Five Inventory Neuroticism; BFIO = Big Five Inventory Openness; IFM = Immediate Family Members; EFM = Extended Family Members.

Table 8.

Pearson product-moment correlations of mindfulness measures and self-efficacy dimensions

Outcome variables	Canonical Variables						
	MAAS	Describe	Observe	Non-Judge	Non-React	Aware	GPA
Cognitive	.30**	.36**	.02	.30**	.23**	.41	.36**
Tech	.21	.27**	.07	.15*	.13*	.27**	.17**
Social	.24**	.36**	.02	.25**	.21**	.32**	.20**

Note. **p* < *.05*. ***p* < *.01*. *N*= 247; Cognitive: Cognitive self-efficacy; Tech: Technological self-efficacy; Social: Social self-efficacy

Table 9.

Results of canonical correlations

Canonical variate	Eigenvalue	F	df (num.)	df (den.)	Squared canonical correlation	Sig. of F test
1	.66	6.77	21	681.09	.40	<.001
2	.03	.78	12	476	.03	<.68
3	.01	.27	5	239	.01	<.93

Table 10.

Canonical solution for the first function: relations between mindfulness scales and academic self-efficacy subscales and academic self-efficacy subscales.

	Function 1	
Canonical variables	Standardized coefficients	Structure coefficients (squared)
MAAS	-.15	.26
Non-judge	.16	.24
Describe	.41	.46
Aware	.52	.49
Non-react	.13	.18
Observe	-.01	.00
GPA	.53	.34
Outcome variables		
Cognitive	.72	.92
Tech	.17	.32
Social	.30	.50

Note. *N* = 251; Cognitive = Cognitive self-efficacy; Tech = Technological self-efficacy; Social = Social self-efficacy.

Table 11.

Canonical redundancy analysis for mindfulness and academic self-efficacy.

Function 1	
Canonical variables	Squared multiple correlations
MAAS	.11
Non-Judge	.10
Describe	.18
Aware	.19
Non-react	.07
Observe	.00
GPA	.14
Outcome variables	
Cognitive	.37
Tech	.13
Social	.20

Table 12.

Pearson product-moment correlations of mindfulness measures and emotional regulation dimensions

Outcome variables	Canonical Variables						
	MAAS	Non-Judge	Describe	Aware	Non-React	Observe	GPA
Approach	-.22**	-.12	-.33**	-.28**	-.36**	-.33**	-.07
Social Support	.04	-.03	.22**	.01	-.03	.07	.09
Avoidance	-.35**	-.28**	-.35**	-.43**	-.24**	-.13*	-.11

*p < .05. **p < .01. *N*=251

Table 13.

Results of canonical correlations

Canonical variate	Eigenvalue	F	df (num.)	df (den.)	Squared canonical correlation	Sig. of F test
1	.42	7.20	21	678.21	.43	<.001
2	.14	4.68	12	474	.03	<.001
3	.1	4.75	5	238	.01	<.001

Table 14.

Canonical solution for three functions: relations between mindfulness scales and subscales and emotional dysregulation subscales.

	Canonical loadings					
Canonical variables	Function 1 Standardized coefficients	Structure coefficients (squared)	Function 2 Standardized coefficients	Structure coefficients (squared)	Function 3 Standardized coefficients	Structure coefficients (squared)
MAAS	.14	.34	-.34	-.04	.18	.17
Non-judge	.09	.16	.21	.00	.51	.40
Describe	.31	.53	-.94	-.34	-.46	-.04
Aware	.60	.53	.31	.00	.47	.32
Non-react	.26	.40	.62	.16	-.26	.04
Observe	.39	.23	.42	.09	-.33	.35
GPA	.16	.04	-.10	-.03	.00	.01
Outcome variables						
Approach	.57	.79	-.83	.05	.76	.15
Social_Support	.04	.06	.94	.55	.47	.40
Avoidance	.55	-.76	.59	.03	-.91	-.20

Note. *N* = 251; Approach = Approach Coping Skills; Social Support = Social Support Approach; Avoidance = Avoidant Coping.

Table 15.

Canonical redundancy analysis

Canonical variables	Function 1 Squared multiple correlations	Function 2 Squared multiple correlations	Function 3 Squared multiple correlations
MAAS	.11	.02	.12
Non-judge	.05	.12	.09
Describe	.14	.06	.18
Aware	.17	.18	.19
Non-react	.12	.14	.14
Observe	.07	.10	.11
GPA	.01	.02	.02
Outcome variables			
Approach	.24	.24	.26
Social_Support	.00	.03	.09
Avoidance	.23	.25	.25

Table 16.

Pearson product-moment correlations of mindfulness measures, animal fluency, coding, and self-efficacy dimensions.

	MAAS	AF	Coding	Tech	Cognitive	Social
MAAS	--	-.08	.00	.08	.07	.04
AF			.30*	.09	-.04	.00
Coding				-.03	-.06	-.14
Tech				--	.59**	.29*
Cognitive					--	.69**
Social						--

Note. *$p < .05$. **$p < .01$. N= 51; Tech = Technological Self-Efficacy; Cognitive = Cognitive Self-Efficacy; Social = Social Self-Efficacy

Table 17.

Pearson product-moment correlations of mindfulness, animal fluency, coding, and coping dimensions.

	MAAS	AF	Coding	Approach	Avoid	Social
MAAS	--	-.08	.01	.08	-.30*	-.04
AF		--	.30*	-.26	.18	-.22
Coding			--	-.19	-.03	-.15
Approach				--	-.60	.34*
Avoid					--	-.07
Social						--

Note. **p* < *.05.* Approach = Academic Approach Coping; Avoid = Avoidant Coping; Social = Social Support

Table 18.

Mediation of the effect of mindfulness on perceived stress through the mediators of approach coping, social support, and academic (cognitive) self-efficacy.

	Point Estimate	Product of coefficients		Bootstrapping					
		SE	Z	Percentile 95% CI		BC 95% CI		BCa 95% CI	
				Lower	Upper	Lower	Upper	Lower	Upper
TOTAL	-.04	.01	-3.00	-.07	-.02	-.07	-.02	-.07	-.02
Approach Coping	-.00	.01	.04	-.01	.02	-.01	.02	-.01	.02
Social Support	-.01	.01	.78	-.02	.01	-.02	.01	-.02	.01
Academic self-efficacy	-.04	.01	2.77	-.06	-.01	-.07	-.01	-.07	-.01
Approach vs. Social Support	.01	.01	.53	-.02	.03	-.01	.03	-.01	.03
Approach vs. self-efficacy	.04	.02	.01	.01	.07	.01	.07	.01	.07
Support vs. self-efficacy	.03	.02	.04	.00	.06	.00	.06	.00	.06

Note. BC, bias corrected; BCa, bias corrected and accelerated, 5000 bootstrap samples.

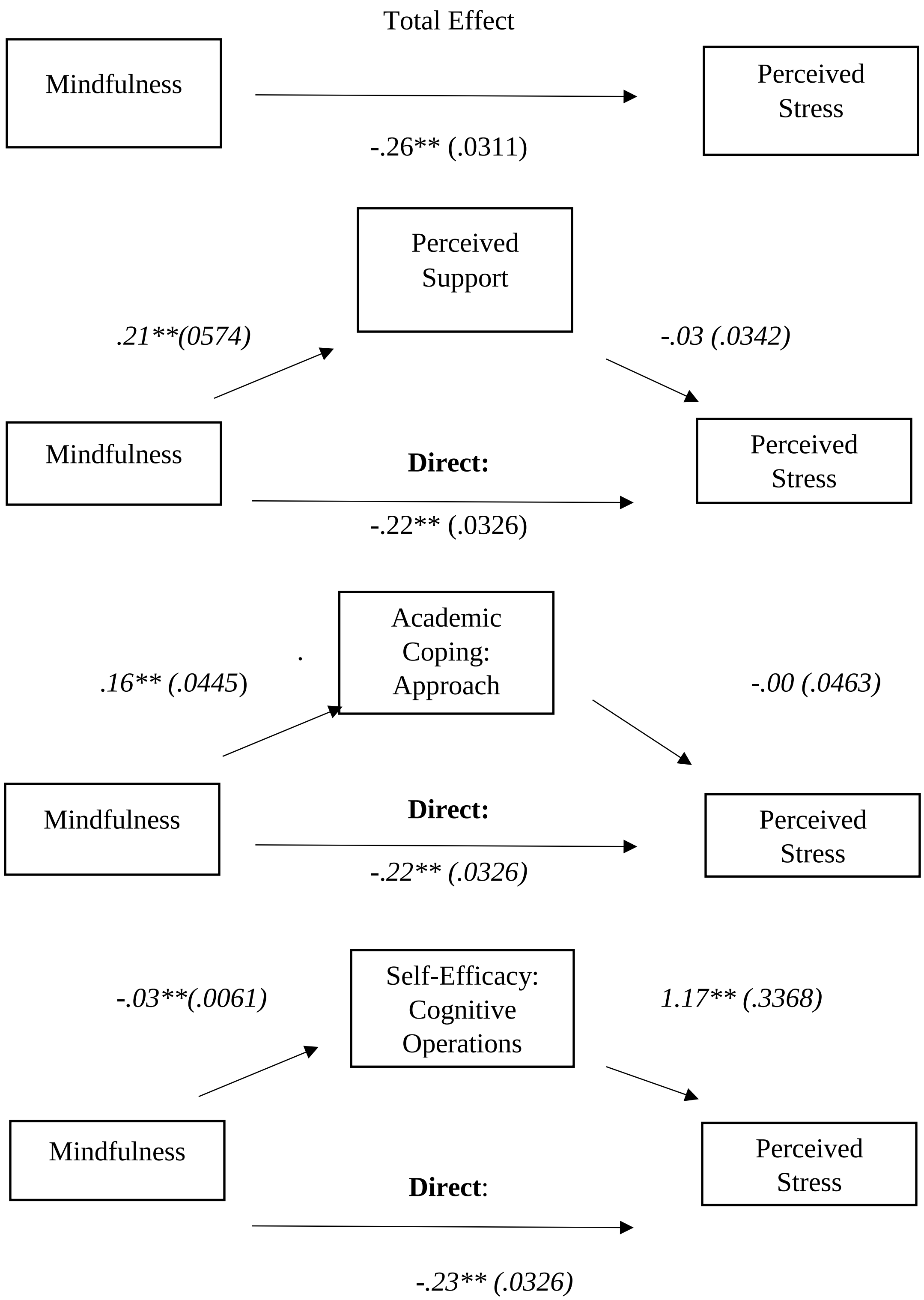

Figure 1. Mediation pathways for multiple mediators between mindfulness and perceived stress. Beta weights are displayed in italics, and standard errors are displayed in italicized parentheses. **p* < .05. ***p* < .01.

Chapter 5: General Discussion

Primary aims and expectations

Many individuals experience positive changes in their psychological states following mindfulness training. Yet the research literature on mindfulness therapy rarely addresses specifically whether gains in mindfulness skills are directly tied to lasting and measurable improvements in health. Additionally, the relations between trait mindfulness and psychophysiological indicators of stress have yet to be investigated. Therefore, the primary aim of this dissertation was to increase what is known about the data relations among mindfulness, emotional states and processes, psychophysiological indicators of stress, and coping resources.

To better understand whether specific mindful processes can be directly linked to these gains, self-report measures of mindfulness were compared to a) physiological indices in response to induction of a mindful state following stress, b) difficulties in emotional regulation, anxiety, perceived stress, and rumination, and c) perceptions of environmental stress and resources available to cope with stress, such as perceived social support and academic self-efficacy and coping. It was expected that mindfulness, defined as peaceful, non-judgmental self-awareness, would be negatively associated with damaging processes such as lasting physiological arousal, rumination, and poor emotional regulation techniques. In contrast, it was expected that mindfulness would be positively associated with lower perceptions of threat in the environment and resources available to cope with stress, such as perceived social support and academic self-efficacy. Across all three studies, outcome measures were collected at one time or very closely in time, Thus, no causal relations could be established among mindfulness, measures of physiological and emotional self regulation, and measures of coping. Associations among variables were emphasized instead.

Thematic results

Mindfulness: a buffer against emotional distress. Taken together, results across the three studies suggest that mindfulness, as a measurable self-reported trait or state, is negatively associated with difficulties in emotional and physiological self-regulation. Essentially, those reporting difficulties regulating their emotions and with more extreme basic psychophysiological responses (i.e., skin conductance) when stressed also report lower levels of mindfulness. With respect to psychophysiological measures, higher ratings on a state measure of mindful responding completed immediately following a mindfulness exercise were associated with a greater drop in skin conductance reactivity, an index of the stress reaction, during the phase when participants were recovering from stress. As discussed in chapter 2, alternate explanations, such as confounds due to participants' physical movement, need to be considered when interpreting this finding. However, these fluctuations in skin conductance in response to a meaningful event are important. An immediate drop in skin conductance reactivity suggests that individuals were aware of their experience while mindfully attending to their breath. In addition, they were more likely to experience calm and less likely to activate the fight-or-flight response. This is important because the fight-or-flight response is metabolically costly and causes damage to the organism over time. The reduction in skin conductance occurred even though these participants had completed a stress task immediately prior to the mindfulness induction, and findings suggest that their level of skin conductance reactivity had increased accordingly.

The implications of the results from study one become clearer when examined in context of findings from studies two and three, which demonstrated that higher self-ratings of mindfulness tend to be associated with lower risks of perceived stress, anxiety, depression, alexithymia, and rumination, regardless of sex, previous psychiatric diagnosis status, or age. Anxious, depressive, and ruminative states are associated with fight-or-flight stress, which is consistent with past literature (Agelink, Boz, Ullrich, & Andrich, 2002), as well as the results from study one, where a personally relevant stress task was associated with raised skin conductance response in participants – an index of "fight-or-flight" reactivity. Results from study three indicate that higher self-ratings on the quality of mindful, non-judgmental awareness of present thoughts, emotions, and sensations were negatively associated with the experience of perceived stress, even among individuals who scored highly on neuroticism.

The perception of threat in the environment, as well as the direct experience of emotional pain, absorbs mental resources which could otherwise be used for problem-solving (Teasdale, 2002). In addition, when attending to painful experiences turns into dwelling on them and leads to mental discomfort, avoidance of emotions and thoughts is reinforced (Linehan, 1993). In the current study, mindful individuals, who were less likely to experience dysphoria, were also less likely to report alexithymic tendencies, especially difficulties with identifying and describing feelings.

These results are important because they suggest that the presence of mindfulness skills makes damaging stress less likely to persist. Environmental stress and challenge will occur in the lives of most individuals, but mindful tendencies are negatively associated with physiological processes that cause permanent physical damage and persistent symptoms of emotional distress. These findings are consistent with past literature on how mindful tendencies protect against depressive relapse (Teasdale et al., 2000; Teasdale et al., 2002). In addition, the current findings suggest that mindful acceptance and the ability to talk about one's experience meaningfully may act as a buffer against the damaging effects of emotional dysregulation. According to Farb and colleagues (2012), mindful open awareness encourages the continual diverting of attentional resources towards recognition of thoughts, emotions, and sensory experiences as they unfold, without dwelling on negative interpretations. For individuals to be able to maintain their attention on potentially painful aspects of experience, such as academic failure, acceptance and self-compassion towards one's own experience is necessary (Neff, Hseih, and Dejitthirat, 2005). Otherwise, awareness of experience might lead to intense self-criticism and become too painful, leading to avoidance, as is often the case among patients with borderline personality disorder (Linehan, 1993). Therefore, the quality of non-judgment supports the noticing of emotional experience, which helps gain information about one's states and needs. But to symbolize the experience and process it, verbally expressing and describing the experience is crucial: Hence the well-documented benefits of therapeutic journaling (Nagel & Anthony, 2009). Future mindfulness interventions would do well to emphasize the training of these skills among university students, which will be further addressed in the clinical implications section.

These findings also highlight how environmental variables may potentially affect the way the intervention is received by participants. Variability in time of day can affect participants' level of alertness and motivation. The presence of physiological and other electronic equipment can distract participants or affect their emotional experience during mindfulness practice. These and other environmental variables, like participants' time commitment and the skill of the interventionist, can affect the effectiveness of the intervention independently of the quality of the mindfulness intervention itself.

This document describes some of the preventive effects of mindfulness on the development of stressful states. Mindful individuals are less likely to perceive threat in the environment or view internal experience as threatening. However, lack of stress is not synonymous with resilience, just like the absence of depression does not necessarily indicate happiness. In fact, an initial stress response, potentially accompanied by emotions of fear or anxiety, is adaptive and necessary to stimulate action in response to challenging circumstances. True resilience is defined by the ability to actively down-regulate a necessary stress response after it has occurred, which ensures that the stress response does not last longer than would be adaptive (Appelhans & Luecken, 2006). To understand how mindfulness is actively associated with resilience, it was important to examine the current findings on mindfulness and active efforts at self-regulating oneself, whether physiologically or behaviorally.

Mindfulness is associated with proactive recovery from stress. The primary aim of the first study was to examine the effects of mindfulness manipulation and to establish the concurrent validity of mindfulness self-report measures. It was expected that participants who had high scores on self-reported mindfulness would also show stronger parasympathetic modulation of heart rate, which is associated with more resilient modulation of stress and reduced stress reactivity across self-regulatory phases. The results indicated that parasympathetic activation was, in fact, positively associated with both state and trait self-ratings of mindfulness during recovery from stress. Specifically, participants rating themselves higher on the describing facet, or the tendency to put one’s thoughts, emotions, and other experiences into words on a mindfulness measure were better able to effectively down-regulate heart rate activity both during stress and during recovery from an emotionally-relevant stressful event. This finding suggests that putting these emotionally-meaningful experiences into words makes individuals more resilient in response to stress. These benefits were observed while the event causing stress was still occurring, as well as immediately after the stressor. It could be expected that the mindful characteristic of describing experience should make it easier for participants to speak to others to obtain validation and other forms of social support. These links between behavioural coping skills and the quality of mindfulness were further examined in study three.

Results from the present group of studies suggest that self-rated mindfulness of the present moment was positively associated with perception of global social support, even while controlling for personality traits like neuroticism and openness-to-experience. Through multivariate analyses, a pattern emerged to show that mindful skills were related to enhanced self-efficacy and academic coping. Undergraduate students who saw themselves as particularly aware of their own activity in the moment, non-judgmentally aware of all aspects of experience, and as likely to find the words to describe their experience, also had confidence in practical domains (i.e., their self-efficacy to seek social support, ability to understand material and perform well academically on future assignments), even while controlling for intelligence. These students were also less likely to report avoidant coping with the stressors and problems in their lives, which is consistent with their self-reported ability to respond to negative emotions and setbacks without self-judgment.

The tendency to put one's experience in words emerged as a crucial skill. Students who lacked high ratings on the describing dimension, even if they rated themselves well on other mindful dimensions (e.g., the tendency to observe their emotions, thoughts, and sensations), tended to rely on a combination of social support seeking and avoidant coping, which suggests lack of active adaptive skills. The tendency to put one's experience into words was also associated with greater seeking of social support for academic issues.

The current findings highlight that mindfulness is associated with a variety of coping skills and resources. Mindfulness traits explain these resilient characteristics independently of personality traits like neuroticism and openness-to-experience. Though mindful individuals are characterized by certain personality traits that are positively perceived by others, the self-rated ability to maintain mindful states is an active process that directly explains adaptive social and academic self-efficacy skills. These results are important because thus far research has only addressed the intersection of mindfulness and coping in a very broad way, by examining global self-ratings of mindfulness and retrospective coping. The ability to non-judgmentally accept present experience, coupled with the tendency to symbolize experience through words, was particularly strongly associated with not only practical coping skills but also self-efficacy, or the secure confidence that one possesses coping skills and is able to use them at the right moment.

The results from this dissertation dovetail with research on dialectical behavioral therapy and cognitive-behavioral therapy on how important it is to symbolize experiences through language. In essence, symbolizing experience through words means viewing an issue as something separate from oneself and malleable, rather than a negative, enduring aspect of the self. Bishop (2004) discussed mindful de-centering, or the ability to view feelings and thoughts as only mental events and not as truths about oneself, the world, or one's relation to the world. This ability to de-identify from a challenging situation in this way reduces the likelihood of developing self-defeating beliefs about oneself and one's coping ability, also reducing emotional pain and avoidance of experience. Therefore, it is not surprising that mindfulness is associated with self-efficacy, or confidence in one's ability to cope.

Overall Limitations and Future Directions

The primary limitation of the current research lies in the use of self-report measures with university students, who were primarily female and between the ages of 18 and 23. The skewed demographics of the sample may have had a direct effect on the results, affecting the validity of the sympathetic reactivity indices for more broadly defined populations. The associations among mindfulness, emotional regulation, and coping were examined for only a narrow population of young adult females. Because these variables are affected by age, experience, and environmental factors, the findings of this dissertation may not necessarily apply to the general population. In addition, the paper data collection, through which data for most of the univariate and all of the multivariate analyses were obtained, was delivered through a long battery of self-report measures taken all at one time. Such data collection is problematic because it is retrospective and prone to the possibility that participants will selectively remember aspects of their experience. It is also affected by participants' fluctuating attention while completing scales, as well as their interpretation of items, over which the researcher has no control. These sources of error are problematic as they are difficult to control methodologically.

Another important limitation is that the current data were collected at a single time-point. Because data was not collected at multiple points in time, longitudinal relations within the data could not be assessed. Although through regressions and canonical correlations it was possible to untangle relations among mindfulness, coping skills, and emotional self-regulation, these findings do not show directly whether mindful skills led to an improvement in emotional and behavioral coping. The hypothesis that mindfulness skills lead to an improvement in coping is important for the development of mindfulness interventions. Future studies are needed to examine the effect of mindfulness training by measuring emotional self-regulation and coping at pre- and post-mindfulness intervention.

Despite these limitations, the current findings are an important source of insight into associations between mindfulness and coping skills which foster resilience. Future studies may continue to clarify the specific associations between mindfulness and social support, which was examined as a global score based on self-report questionnaire methods in the current study. Social support can be more directly assessed through methods like ecological momentary data or interview measures. Interviews can be coded to evaluate of how individuals cope with an immediate, specific situation, providing a wealth of information which is amenable to qualitative as well as quantitative analysis. Future studies can further explore the associations between mindfulness, emotional resiliency, and coping suggested within the current research by taking a methodological approach, which reduces biases and sources of error to which the current research is prone.

Clinical Implications

The results from the triad of presented studies have significant implications for the treatment of disorders associated with emotional dysregulation, such as anxiety and depression. The current study contributes to the small but growing research stream which establishes links between mindfulness and psychophysiological reactivity. The results show directly that a simple mindfulness task, when practiced with attention to the instructions, was directly associated with a reduction in sympathetic reactivity during the mindful task. This finding directly supports the effectiveness of mindfulness-based therapy for lowering stress and anxiety.

In addition, the current research has important implications for the development of mindfulness-based treatment programs. The current findings show how specific mindful skills in combination are associated with abilities associated with effective coping and resilience. Future mindfulness-based programs may take advantage of this knowledge by specifically targeting the skills of non-judgment, the ability to describe emotions and thoughts, and acting with awareness, which seem to be especially strongly associated with active coping and emotional awareness. The current research provides direct evidence that these skills, when they work synergistically, are associated with the development of adaptive skills and attitudes that help students achieve success. In future, university settings which disseminate mindfulness treatment programs to students can emphasize these dimensions when measuring pre- to post-intervention change. The current findings suggest that mindfulness may protect university students against stress by raising their perception of healthy social resources, building perceived self-competence, and promoting active coping with challenges.

A meaningful aspect of the current research is the finding that mindfulness is associated with adaptive attitudes towards self and others. Mindful university students perceived a higher level of support available, were less likely to perceive their environment as stressful, and saw themselves as able to perform well academically and learn new academic and practical skills. These findings are consistent with past research on self-compassion, an open-minded attitude which emphasizes non-judgmental acceptance, and which is associated with active problem solving and better coping with perceived failure among university students (Neff, 2005).

Conclusions

Thus far, research on mindfulness has shown little consensus on the active ingredients of mindfulness intervention. Typically, research on mindfulness interventions focuses on measurement of stress reduction exclusively using paper-and-pencil questionnaires which target change in anxiety and depression symptoms. The current study contributes to the research literature on mindfulness because it validates self-report questionnaires on mindfulness states and traits against physiological reactivity, demonstrating that mindfulness self-ratings are associated with healthy self-regulation in a variety of states, including during mindfulness practice, while dealing with a challenge, and resting at baseline. Moreover, the results of this dissertation offer support for how mindful skills may protect against emotional dysregulation by studying the combination of mindful skills most strongly associated with adaptive self-regulation skills. Additionally, these results contribute to research on mindfulness by establishing links between mindfulness and adaptive coping, suggesting that mindfulness skills can not only alleviate pathological symptoms but might increase resilience as well. These findings have important implications for the development of future mindfulness interventions and the measurement of mindfulness change.

Study Hypotheses	Statistical Analyses	Dependent variables	Sample/How data collected
Study 1			
Hypothesis I Validating the task: A rise in sympathetic reactivity is expected to occur between the baseline and the recall task; A drop in sympathetic reactivity is expected during the calming phase and the recovery baseline	Four directional within contrasts	SCR, DBP, SBP, HR	55 participants fluent in English and without previous history of cardiovascular/pulmonary disease or allergies to medical equipment
Hypothesis II Measures of mindfulness and physiological reactivity: Individuals who score highly on the MAAS and the FFMQ and TMS will show greater parasympathetic (PNS) modulation of the heart at rest, during the calming phase, during the MBE, and during the recovery phase**.** High self-ratings on the mindfulness variables will be negatively related to SBP, DBP, HR and SCR during the autobiographical stress task and during baseline.	Bivariate correlations Linear regressions, if covariates are identified.	Self-Report MAAS, FFMQ subscales, TMS; Physiological variables: HR, SBP, DBP, HRV variables (Frequency: LF/HF HRV, LF HRV/Total Power; Time Domain: SDNN, RMSSD, pNN50), SCR. Control variables: see Table 2 for Study 1	Same as Hypothesis I
Study 2			
Hypothesis I: Mindful individuals will be less likely to report high levels of anxiety and depression symptoms.	Bivariate correlations between mindfulness scales FFMQ, MAAS, and BDI and STAI will be carried out	FFMQ five subscales, MAAS, BDI and STAI	250 fluent speakers of English
Hypothesis II: Mindful individuals will be less likely to report proneness to emotional regulation difficulties.	Canonical correlation analysis	Canonical variables – MAAS and the FFMQ subscales; Outcome variables: three	250 fluent speakers of English

Specifically, mindful individuals will be less likely to report difficulties in recognizing and accepting their emotions, performing goal-related activities despite the presence of strong emotions, and accessing emotional regulation strategies perceived as effective.		DERS subscales.	
Hypothesis III: Mindful individuals will be less likely to report rumination, or to experience a greater tendency to reflect anxiously or gloomily on their emotions.	Three multiple regressions with gender and age included as covariates	Mindfulness predictors (three): non-judge and observe dimensions of FFMQ and the MAAS Outcome variable: rumination subscale of RRQ.	250 fluent speakers of English
Hypothesis IV: Mindful individuals will be less likely to report rumination, even following discussion or a recurrent stressor experienced in daily life.	Same as for hypothesis III	Same as for Hypothesis III, except that the outcome variable (RRQ rumination) will be collected at the end of the experimental protocol for Study 1	55 fluent speakers of English with no previous history of cardiovascular/pulmonary disease and no allergies to medical equipment
Hypothesis V: Mindful individuals will be less likely to report high scores on alexithymia scales.	A canonical correlation analysis will be carried out to investigate the multivariate relations between self-rated mindfulness and alexithymia, which are predicted to be negative.	The canonical variables will include MAAS and the FFMQ subscales; the outcome variables will include the three alexithymia subscales.	250 fluent speakers of English
Study 3			
Hypothesis I. Mindfulness and primary appraisal of threat: High scores on mindfulness measures, including the MAAS and the FFMQ will be negatively associated with	A hierarchical ordinary least squares (multiple) regression will be used to test the prediction that mindfulness predicts more adaptive primary appraisals of	The Perceived Stress Scale will be the dependent variable. Neuroticism will be entered in Step 1 and the MAAS will be entered in	250 fluent speakers of English (same as Study 2 data collection)

scores on the Perceived Stress Scale. It is expected that high scores on all facets of the FFMQ, including neuroticism, or the tendency to experience negative emotions, and openness-to-experience, which reflects intellectual curiosity and preference for novelty, will need to be included as controls. It is expected that mindfulness skills will be associated with lower perceived stress, and that the relation will not be better explained by these stable personality variables.	stress while controlling for openness-to-experience.	Step 2.	
Hypothesis II Mindfulness and perceived social support: Participants who score highly on self-report measures of mindfulness skills will have higher self-ratings on a measure of perceived social support, while controlling for neuroticism and openness-to-experience.	Two hierarchical ordinary least squares (multiple) regressions	Neuroticism (or Openness-to-Experience) will be entered in Step 1, followed by trait anxiety (STAI), depression (BDI), and number of family members residing in area. MAAS will be entered in Step 3. Control variables: strength of social network, depression, and trait anxiety	250 fluent speakers of English
Hypothesis III Mindfulness and self-appraisals of academic self-efficacy and specific academic coping skills: High self-ratings on mindfulness scales will be associated with high self-ratings on measures of academic self-efficacy when faced with a specific academic challenge – a difficult exam.	A canonical correlation analysis to evaluate how mindfulness predicts self-appraisals of academic self-efficacy (CASEI) while controlling for GPA and general intelligence variables A second CCA with academic coping (ACSS) as outcome variable	Canonical variables include MAAS, FFMQ subscales, GPA, and general intelligence (Animal Fluency and Coding). Outcome variables: CASEI and ACSS self-reports	250 fluent speakers of English

Hypothesis IV Complex mediation and SEM: It is expected that self-efficacy, approach coping, and perceived social support will mediate the relation between mindfulness skills and perceived stress.	Complex mediation model with MAAS as predictor and perceived stress (PSS) as outcome variable, and self-efficacy (CASEI), approach coping (subscale of ACSS), and perceived social support.	Path a: correlations will be run between mindfulness, perceived stress and the mediator variables. Path b: In separate regressions, the three mediators will be regressed on perceived stress, while controlling for mindfulness. Bootstrapping will be used to test for mediation. This approach creates a sampling distribution of the a and b pathways.	250 fluent speakers of English

Figure 4. All study hypotheses, analyses, and dependent variables.

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Appendix A

Demographics and Health Questionnaire

I would like to start by asking you some background information about you and your educational and health history. Please try to be as truthful as possible when answering these questions, but please be assured that the answers you give will be kept confidential. The purpose of these questions is to help us identify variables that might influence physiological reactivity on indices such as breathing rate and heart rate.

Date of Birth:___________________Height:_______________Weight:_______________

Gender (check one): ______Male _____Female _____Other (specify):_________

Race/ethnic background: (please circle)

[1] ABORIGINAL

[2] ASIAN OR ASIAN DESCENT

[3] HISPANIC/LATINO

[4] NON-HISPANIC BLACK OR AFRICAN DESCENT

[5] NON-HISPANIC WHITE OR CAUCASIAN

[6] OTHER/MIXED Please describe:

[7] PREFER NOT TO ANSWER

Year in university (check one): ___ 1st year ___ 2nd year ___ 3rd year ___ 4th year ___ 5th year ___ Beyond 5 years

What is your GPA? _________(if you are in your 1st year, include your high school average)

Please Check Yes or No:

1. Have you ever been hospitalized (kept at the hospital overnight or longer)? .... o YES o NO

If yes, please specify?

____

2. Have you ever had surgery? ....o YES o NO

If yes, please specify?

____

3. Are you presently taking any medications or pills (including aspirin, and other over-the-counter medication)?

……… o YES o NO

If yes, please specify?

____

4. Are you presently taking any vitamins, supplements, and/or herbal supplements? If yes, please specify?

……………………………………………………………………………………………….o YES o NO

____

5. Do you have high blood pressure (hypertension) or low blood pressure (hypotension)?

……………………………………………………………………………………………… o YES o NO

6. Have you ever been told that you have a heart problem?

……………………………………………………………………………………………… o YES o NO

7. Have you ever been told that you have a heart murmur?
……………………………………………………………………………………………… o YES o NO

8. Do you have a machine that regulates your heart beat?

……………………………………………………………………………………………… o YES o NO

9. Have you ever had racing of your heart or skipped heartbeats?
……………………………………………………………………………………………… o YES o NO

10. Has anyone in your family died of heart problems or a sudden death before age 50?

……………………………………………………………………………………………… o YES o NO

11. Do you have Diabetes?

……………………………………………………………………………………………… o YES o NO

12. Do you have Asthma or any other breathing problems?
……………………………………………………………………………………………… o YES o NO

If yes, please specify?

____

13. Do you have any type of cardiovascular disease?
……………………………………………………………………………………………… o YES o NO

If yes, please
specify?____

14. Have you had any other medical problems (infectious mononucleosis, etc.)?

……………………………………………………………………………………………… o YES o NO

15. Have you had any medical problems since your last physical?

.... o YES o NO

16. Do you smoke?

....o YES o NO

17. Do you aerobically exercise (e.g., walking) for > 30 minutes, > 2 times per week?

.... o YES o NO

18. If you are female, please specify when your last menstrual period occurred.

____

19. Do you have any skin allergies, including allergies to medical equipment or latex?

.... o YES o NO

20. Have you ever been diagnosed with any of the following (please check all that apply):

[ ] Schizophrenia [ ] Bipolar Disorder (Manic Depressive)

[ ] Psychosis [ ] Anxiety Disorders/Panic Disorder

[ ] ADHD/ADD [ ] Obsessive-Compulsive Disorder

[ ] Learning Disability other than ADD/ADHD [ ] Major Depression or Dysthymia

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To be answered during the EXPERIMENTAL Session (Session Part 2):
1. Have you had any caffeinated beverages in the past 12 hours? (Soda, coffee, or tea)
.... o YES o NO

2. Have you had any alcoholic beverages in the past 24 hours?

____o YES o NO

2. Have you engaged in any physical activity in the past 24 hours (e.g., running up the stairs to the experimental session)?
.... o YES o NO

If yes, please
specify?____

3. Have you had any recent experience that has strongly influenced your emotional state beyond the ordinary? (This is relevant due to the physiological data we are collecting)
.... o YES o NO

Appendix B

Five Facet Mindfulness Questionnaire

Please rate each of the following statements using the scale provided. Write the number in the blank that best describes your own opinion of what is generally true for you.

1	2	3	4	5
never or very rarely true	rarely true	sometimes true	often true	very often or always true

_____ 1. When I'm walking, I deliberately notice the sensations of my body moving.
_____ 2. I'm good at finding words to describe my feelings.
_____ 3. I criticize myself for having irrational or inappropriate emotions.
_____ 4. I perceive my feelings and emotions without having to react to them.
_____ 5. When I do things, my mind wanders off and I'm easily distracted.
_____ 6. When I take a shower or bath, I stay alert to the sensations of water on my body.
_____ 7. I can easily put my beliefs, opinions, and expectations into words.
_____ 8. I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted.
_____ 9. I watch my feelings without getting lost in them.
_____ 10. I tell myself I shouldn't be feeling the way I'm feeling.
_____ 11. I notice how foods and drinks affect my thoughts, bodily sensations, and emotions.
_____ 12. It's hard for me to find the words to describe what I'm thinking.
_____ 13. I am easily distracted.
_____ 14. I believe some of my thoughts are abnormal or bad and I shouldn't think that way.
_____ 15. I pay attention to sensations, such as the wind in my hair or sun on my face.
_____ 16. I have trouble thinking of the right words to express how I feel about things
_____ 17. I make judgments about whether my thoughts are good or bad.
_____ 18. I find it difficult to stay focused on what's happening in the present.
_____ 19. When I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it.
_____ 20. I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.
_____ 21. In difficult situations, I can pause without immediately reacting.
_____ 22. When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words.
_____ 23. It seems I am "running on automatic" without much awareness of what I'm doing.
_____ 24. When I have distressing thoughts or images, I feel calm soon after.
_____ 25. I tell myself that I shouldn't be thinking the way I'm thinking.
_____ 26. I notice the smells and aromas of things.
_____ 27. Even when I'm feeling terribly upset, I can find a way to put it into words.
_____ 28. I rush through activities without being really attentive to them.

_____ 29. When I have distressing thoughts or images I am able just to notice them without reacting.
_____ 30. I think some of my emotions are bad or inappropriate and I shouldn't feel them.
_____ 31. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.
_____ 32. My natural tendency is to put my experiences into words.
_____ 33. When I have distressing thoughts or images, I just notice them and let them go.
_____ 34. I do jobs or tasks automatically without being aware of what I'm doing.
_____ 35. When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about.
_____ 36. I pay attention to how my emotions affect my thoughts and behavior.
_____ 37. I can usually describe how I feel at the moment in considerable detail.
_____ 38. I find myself doing things without paying attention.
_____ 39. I disapprove of myself when I have irrational ideas.

Appendix C

Mindfulness Practice - History Questionnaire

Instructions: Below is a list of categories representing a variety of mindfulness practices that you may or may not have experience with in your life. Using the 1-5 scale below, please circle the number that best represents the amount of time you have ever spent with these practices.

0	1	2	3	4	5
Never	Less than 6 months	7 months – 2 years	3 – 5 years	6-10 years	11 or more years

Tai Chi/Qui Gong...0 1 2 3 4 5

Hatha Yoga...0 1 2 3 4 5

Mindfulness Meditation/Vipassana...0 1 2 3 4 5

Transcendental Meditation..0 1 2 3 4 5

Devotional Practices….(list)______________________,……0 1 2 3 4 5

Other practices…(list)_________________________,…...0 1 2 3 4 5

Other practices…(list)_________________________,…...0 1 2 3 4 5

Other practices…(list)_________________________,……0 1 2 3 4 5

Appendix D

Day-to-Day Experiences

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

1. I could be experiencing some emotion and not be conscious of it

until some time later...1 2 3 4 5 6

2. I break or spill things because of carelessness, not paying attention,

or thinking of something else 1 2 3 4 5 6

3. I find it difficult to stay focused on what's happening in the present

....1 2 3 4 5 6

4. I tend to walk quickly to get where I'm going without paying attention

to what I experience along the way..1 2 3 4 5 6

5. I tend not to notice feelings of physical tension or discomfort until they

really grab my attention...1 2 3 4 5 6

6. I forget a person's name almost as soon as I've been told it for the first time

....1 2 3 4 5 6

7. It seems I am "running on automatic", without much awareness of what I'm doing

....1 2 3 4 5 6

8. I rush through activities without being really attentive to them.

....1 2 3 4 5 6

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.

....1 2 3 4 5 6

10. I do tasks and jobs automatically, without being aware of them

....1 2 3 4 5 6

11. I find myself listening to someone with one ear, doing something else at the same time

....1 2 3 4 5 6

12. I drive or walk to places on 'automatic pilot' and then wonder why I went there.

....1 2 3 4 5 6

13. I find myself preoccupied with the future or the past.

....1 2 3 4 5 6

14. I find myself doing things without paying attention.

....1 2 3 4 5 6

15. I snack without being aware that I'm eating.

....1 2 3 4 5 6

Appendix E

The mindful breathing observation task

Many meditation traditions teach that meditation, by cultivating mindfulness, helps us to experience the present more consciously and allows us to better appreciate it. In the course of daily life, our thoughts often dwell on the past or future. Mindfulness meditation brings us back to the moment of our present experience.

The mindful observation of breathing is a very common method of meditation. Through this method, the breath is observed in the here-and-now. We consciously sense the changes in the body, as the breath enters and exiting the abdomen or chest. The aim is to remain in this state of conscious observation, and not to let the mind wander and get lost in thought.

This experiment is based on this mindful observation approach.

Please take some time and try out the mindful breathing observation for a few breaths.

Sit in a relaxed, semi-reclined position and lean back in the chair if you want to.

The breath can usually be sensed best through the rising of the abdomen or chest, or through the air entering or exiting the nose.

Let the breath flow in and out and find out for yourself where you experience your breath best. Observe your breath for at least five breaths and close your eyes, if that is comfortable for you.

Try to keep your attention on your breath in the present moment.

Then read on.

Your task in the following exercise is to openly and consciously observe your breath. It is true, however, that after some time, most people get lost in thought, wander, and lose contact with their awareness of their breath in the present moment.

In order to detect whether you are staying with your perception of your breath, a signal will sound at random times through the headphones.

When you hear this signal, we ask that you notice whether you were in the state of mindful breathing observation, or whether your mind had been wandering until you were "brought back" to mindful awareness by the tone.

If you notice at the signal that you have lost track of your breath and therefore the perception of the here-and-now--for example, because you have become lost in thought or started daydreaming—gently bring your mind back to the present moment.

Also, notice every time you realize, without hearing the signal, that your mind had wandered, and you have just come back to the awareness of the breath in the moment.

Most people find that they repeatedly lose focus and mind-wander during this exercise. Simply try to stay in the here-and-now using the breathing observation, and be aware of how well you are doing this. If notice that you have lost focus, do not judge or evaluate this fact, but simply accept it and return back to the perception of the breath.

As much as possible, close your eyes while observing your breath. If you feel uncomfortable closing your eyes, you may sit with your eyes slightly open and relaxed. Try to gaze downward at a fixed point.

After some time the experiment will end automatically, of which you will be notified through the headphones.

If you don't have any more questions, please click "Start", and then close your eyes! The rest of the instruction is given through the headphones.

Auditory instructions:

1) Sit down now upright and relaxed on the chair. If you'd like, you may lean back in the chair in a semi-reclined position. The signal, at which you should notice whether you are observing your breathing or are lost in thought and no longer in contact with your breathing or observation of the present is the following:
2) Ding...
3) When this signal sounds, please take note of whether you were observing your breathing at the moment of the signal, or if your attention has strayed from your breath in the here-and-now.
4) Now begin the mindful breathing observation. Let your breath calm down naturally. Pay attention to your breath in the here-and-now, without trying to change it. Observe your breathing in either your abdomen, chest, or nose--wherever you can best feel it. Remain in the present moment.
5) Now try to maintain this alert attitude while observing your breath. During the following experiment, the signal will be played at different points in time. The actual experiment starts now!
6) From time to time you may notice that your mind wanders. And when you notice this, just acknowledge that this is what minds do. Take this opportunity to notice that the mind has wandered. Then, gently bring your attention back to the breath.
7) Check in from time to time to see where your mind is, and check in with your posture, to see whether it is embodies a sense of being awake.
8) Feel the natural flow of your breath. You don't need to control or change or do anything to your breath. Notice where you feel your breath in your body….it may be in your abdomen, in your chest, in your nostrils. See if you can feel the sensations of your breath as you draw it in and let it out.

Appendix F

Toronto Mindfulness Scale

Instructions: We are interested in what you just experienced. Below is a list of things that people sometimes experience. Please read each statement. Next to each statement are five choices: "not at all," "a little," "moderately," "quite a bit," and "very much." Please indicate the extent to which you agree with each statement. In other words, how well does the statement describe what you just experienced, just now?	Not at all	A little	Moderately	Quite a bit	Very Much
1. I experienced myself as separate from my changing thoughts and feelings	1	2	3	4	5
2. I was more concerned with being open to my experiences than controlling or changing them.	1	2	3	4	5
3. I was curious about what I might learn about myself by taking notice of how I react to certain thoughts, feelings or sensations.	1	2	3	4	5
4. I experienced my thoughts more as events in my mind than as a necessarily accurate reflection of the way things 'really' are.	1	2	3	4	5
5. I was curious to see what my mind was up to from moment to moment.	1	2	3	4	5
6. I was curious about each of the thoughts and feelings that I was having.	1	2	3	4	5
7. I was receptive to observing unpleasant thoughts and feelings without interfering with them.	1	2	3	4	5
8. I was more invested in just watching my experiences as they arose, than in figuring out what they could mean.	1	2	3	4	5
9. I approached each experience by trying to accept it, no matter whether it was pleasant or unpleasant.	1	2	3	4	5
10. I remained curious about the nature of each experience as it arose.	1	2	3	4	5
11. I was aware of my thoughts and feelings without overidentifying with them.	1	2	3	4	5
12. I was curious about my reactions to things.	1	2	3	4	5
13. I was curious about what I might learn about myself by just taking notice of what my attention gets drawn to.	1	2	3	4	5

Appendix G

Social Competence Interview

The Social Competence Interview (SCI) is designed to measure a person's cardiovascular responses to discussing an emotionally arousing topic with a sympathetic interviewer and to provide data for assessing dimensions of social competence and interpersonal style. The interview focuses on a problem that is important to the individual and represents a source of recurring conflict or personal stress. This interview has been condensed to a 15-min version. The main goal of the SCI is to help the participant who is being interviewed re-experience stressful emotions by reconstructing a distressing experience in detail. Guided imagery methods are used to induce and maintain emotional arousal. This experiential focus is maintained for the first 4 minutes of the interview; in the remaining 8 minutes, personal strivings, strategies, and expectations that underlie social competence are addressed. Cardiovascular responses are recorded before, during, and after the interview to assess physiologic changes associated with emotion.

Minutes 1-4: Experiential Focus

Minutes 4-12: Personal Strivings, Strategies, Expectations

Minutes 12-15: Calming Phase (Discussion of Neutral Issue)

IDENTIFY GENERAL PROBLEM → DESCRIBE SPECIFIC SITUATION → DESCRIBE ASSOCIATED EMOTIONS ⇆ IDENTIFY CORE THOUGHTS THAT ACTIVATE STRESSFUL EMOTIONS

PHASE I

- Explain purpose of interview:

  To find out how you respond to things that make you feel stressed.

- Tell participant how long interview will last (12-15 minutes).
- Seat participant. Hook up physiological equipment (electrodes and respiratory belt transducer). Chat pleasantly. Ask if participant has any questions about procedure.

- Pre-interview relaxation baseline:

  "Please sit quietly and relax for a few minutes".

During the 7 minute baseline, the participant is asked to sit quietly and relax, while physiological data is being collected.

See Appendix A II for further details

Introduce the interview:

We want to find out how you react to stress. Some of the other things you have done (or will do) here show how your body responds to mental or physical stress. But we also need to know how you react to your own personal kinds of stress. During the next 12 minutes I want us to talk, and I want you to tell me what is personally stressful for you. This is an opportunity for you to tell us what you find stressful.

I will give you a list of situations people your age find stressful and I will ask you to choose one for us to talk about. Just think of this as your chance to tell us what you find stressful. I will ask you some questions and from time to time it may sound like I am repeating a question or emphasizing a particular point. I won't be doing this to give you a hard time, but to try to be sure I understand how that stress really feels to you.

We want you to feel in the interview for just a few minutes the way you feel outside this room when you are under stress. But if I start to ask about anything you don't want to discuss, just let me know. If there is anything you wouldn't like to talk about, you don't have to. This is not a test of any sort.

Stress Hierarchy (Card Sort):

These cards list common kinds of stress university students' experience. Some of these problems may have happened to you. Please look them over and decide which ones have caused you the most stress during the past few months (school year). I want you to sort the cards so that the one with the most stressful problem is on top, the next most stressful problem is right behind it, the third most stressful problem is next, and so on with the least stressful problem at the very bottom of the deck. If there are problems you don't want to talk about, you don't have to.

PHASE II

IDENTIFY PROBLEM situation in which an **important self-goal** was **threatened**.

Minutes 0-2

- Objective: help the participant **re-experience thoughts**, **behaviors**, and **emotions** related to this situation.
- Have the participant **reconstruct** the **situation** in **detail** to **trigger** the re-experiencing of **troubling thoughts** and **emotions**.
- Focus is on **THOUGHTS** and **EMOTIONS** at **all times – NOT** the **situational details.**
- Stressful **emotions** can be caused by many things but they typically are **triggered** and **organized** by **cognitive appraisals**. (Perception that an important self-goal/striving is threatened).
- Stressful **emotions** are **reactivated** during interview by **activating appraisal**, or **CORE THOUGHT**.
- Make sure that the problem selected is the **MOST SIGNIFICANT/TROUBLING ONE** the participant is willing to discuss.

DEFINING THE PROBLEM: **STRESSFUL, IMPORTANT, AND OCCURS OFTEN?**

- *Tell me about…* (most important stressor on Card #1)
- *Why did you choose this particular topic?*
- *Why is this a problem for you?*
- *Why is this problem important to you?*
- *How long has this been a problem?*
- *How often does it bother you?*

RECALLING A STRESSFUL SITUATION:

- *Can you tell me about a specific situation when this problem happened?*
- *…a specific time when you felt stressed?*
- *…a situation when this problem came up?*
- *Where did this happen?*
- Who was there and what was happening

PHASE III

RE-EXPERIENCING THE PROBLEM SITUATION (MINUTES 2 TO 4)

Help the participant **focus** on **feelings aroused** in the problem situation.

Help the participant **elaborate** on his or her **core thoughts** and **feelings** in the situation.

Encourage participant to **recall stressful feelings**.

1. Encourage participant to RECALL STRESSFUL FEELINGS experienced during problem situation:

- *How did you feel?*
- *Is that all you were feeling? Was there anything else?*
- *What was it like for you when you felt _____?*
- *What were you like when you felt _____?*
- *How did you look to others when you were feeling like that? What did they see?*
- *How did you act when you were feeling like that?*
- *What did you do in the situation you're telling me about?*
- *How did other people react? How did that make you feel?*
- *How did you feel physically?*

2. Relate those feelings to SPECIFIC THOUGHTS that triggered them:

- *What was going through your mind when you were feeling _____?*
- *What was going though your mind when you were doing _____?*
- *What went through your mind when (other person) did/said _____?*
- *What did you say to yourself when that happened?*
- *Was there anything else you wanted to say but did not say?*
- *What did you really want to say?*
- *When you think about that situation now, what goes through your mind?*
- *Why do these thoughts come to mind?*
- *How do these thoughts make you feel now?*

If the participant has difficulty expressing stressful thoughts and feelings prompt with:

- *Think about the last time this problem happened. Why don't you want this to happen again?*
- *Why would it be stressful for you if this problem happened again? What would be bad about it?*
- *Why does this problem bother you? What comes to mind when you think about it?*

Elaboration of a feeling statement:

- *How did that feel?*
- *Was that all you felt? Did you feel anything else?*
- *Tell me what that was like for you – when you felt _____*
- *What were you like when you felt that way?*
- *Could others see that you were feeling _____? How?*
- *How do you act when you feel _____?*

Elaboration of stressful thoughts behind emotion:

- *What was going through your mind when you were feeling _____?*
- *What went through your mind when he said/did that?*
- *What did you say to yourself when that happened?*
- *Was there anything you wanted to say but did not say?*
- *What do you wish you had said?*
- *When you think about that situation now what goes through your mind?*

3. PLAY BACK the situation AGAIN, encouraging expression of thoughts and feelings perhaps not mentioned before.
See Appendix AVII for further details

- Ok, I want to be sure I really understand what this was like for you. Could you take me through this situation again?
- *I'd like you to take a moment to imagine the situation now. Put yourself back on the scene and imagine it all happening again. Picture the place where you were. Picture the other people who were there and how they looked and acted*
- *OK, help me picture this.*
- *Where is this happening?*
- *Who is there?*
- *How do they look? What does their face look like? What does their voice sound like? How are they acting?*
- *What goes through your mind when they say that… look/sound/act that way?*
- *What do you say to them? …What do you want to say?*
- *What do you want to happen? What are you trying to do?*
- *Why is this important?*
- *What happens next?*
- *How does this make you feel physically?*
- *How do you feel about the way they are acting/reacting?*

4. Assess the situation's IMPACT:

- *Did you tell anyone else about this? …How did they react?*
- *How did that make you feel?*
- *How did you act?*
- *What went through your mind?*
- *Why did you think that?*
- *Why was that important?*
- *How do you feel now when you think about this?*
- *How do you feel about yourself as a result of this?*
- *How do your family or friends make you feel?*

PHASE IV

CALMING PHASE (MINUTES 1 2 TO 15)

Discussion of neutral issues not associated with stress (the purpose of this portion is to help the participant return to physiological and emotional baseline).

- *Now, we have spent some time discussing an issue that causes you stress. Let's talk about something different.*
- *What do you like to do in your spare time?*
- *What are your plans for the rest of the summer/winter break?*

Post-Interview Baseline: The participant is asked to sit quietly as physiological data is collected.

Appendix H

Validation of Emotional Response to the SCI

Now, I will ask you to rate your engagement with the experience you've just recalled.

1. As you think of this situation/event now, how anxious are you on a scale of 1 to 7 (where 1 means not at all anxious, and 7 means extremely anxious)?	
2. How angry do you feel, on a scale of 1 to 7 (where 1 means not at all angry, and 7 means extremely angry)?	
3. How frustrated do you feel, on a scale of 1 to 7 (where 1 means not at all frustrated, and 7 means extremely frustrated)?	
4. How greatly do you feel you were able to control your emotional responding in response to this exercise, on a scale of 1 to 7?	
5. On a scale of 1 to 7, how strongly did you re-experience the situation during this exercise (where 1 means not at all strongly, and 7 means very intensely)?	
6. On a scale of 1 to 7, how vividly did you visualize the situation during the imagination exercise (where 1 means you could not picture it, and 7 means you could see it very vividly?)	

Appendix I

Blood Pressure and Heart Rate Readings during Baseline, SCI and Recovery Phase

Date:	Time:	ID:
Baseline (5 readings):		
2 minutes		
Systolic BP:	Diastolic BP:	Pulse:
4 minutes		
Systolic BP:	Diastolic BP:	Pulse:
6 minutes		
Systolic BP:	Diastolic BP:	Pulse:
8 minutes		
Systolic BP:	Diastolic BP:	Pulse:
10 minutes		
Systolic BP:	Diastolic BP:	Pulse:
SCI (1 reading):		
Systolic BP:	Diastolic BP:	Pulse:
Recovery (5 readings):		
2 minutes		
Systolic BP:	Diastolic BP:	Pulse:
4 minutes		
Systolic BP:	Diastolic BP:	Pulse:
6 minutes		
Systolic BP:	Diastolic BP:	Pulse:
8 minutes		
Systolic BP:	Diastolic BP:	Pulse:
10 minutes		
Systolic BP:	Diastolic BP:	Pulse:

Appendix I

Beck Depression Inventory – Short Form

This is a questionnaire. On this questionnaire are groups of statements. Please read the entire group of statements. Then pick out the one statement in that group that best describes the way you feel TODAY, that is, right now. Circle the number beside the statement you have chosen. If several statements in the group seem to apply equally well, then circle each one.

1	a I do not feel sad. b I feel sad or unhappy. c I am unhappy or sad all of the time and I can't snap out of it. d I am so sad or unhappy that I cannot stand it.
2	a I am not particularly pessimistic or discouraged about the future. b I feel discouraged about the future. c I feel I have nothing to look forward to. d I feel that the future is hopeless and that things cannot improve.
3	a I do not feel like a failure. b I feel I have failed more than the average person. c As I look back on my life, all I can see is a lot of failures. d I feel I am a complete failure as a person (parent, husband, wife).
4	a I am not particularly dissatisfied. b I don't enjoy things the way I used to. c I don't get satisfaction out of anything any more d I am dissatisfied with everything
5	a I don't feel particularly guilty. b I feel bad or unworthy a good part of the time. c I feel quite guilty d I feel as though I am very bad or worthless
6	a I don't feel disappointed in myself. b I am disappointed in myself c I am disgusted with myself d I hate myself
7	a I don't have any thoughts about harming myself. b I feel I would be better off dead c I have definite plans about committing suicide d I would kill myself if I could
8	a I have not lost interest in other people. b I am less interested in other people than I used to be c I have lost all of my interest in other people and have little feeling for them. d I have lost all of my interest in other people and don't care about them at all.
9	a I make decisions about as well as ever. b I try to put off making decisions c I have great difficulty in making decisions d I can't make decisions anymore.
10	

	a I don't feel I look any worse than I used to. b I am worried that I am looking old or unattractive c I feel that there are permanent changes in my appearance and the make me look unattractive. d I feel that I am ugly or repulsive looking.
11	a I can work about as well as before. b It takes extra effort to get started at doing something. c I have to push myself very hard to do anything d I can't do any work at all.
12	a I don't get more tired than usual. b I get tired more easily than I used to. c I get tired from doing anything. d I get too tired to do anything.
13	a My appetite is no worse than usual. b My appetite is not as good as it used to be. c My appetite is much worse now. d I have no appetite at all anymore.

Appendix J

State Trait Anxiety Inventory – Form Y-1 (State Inventory)
SELF-EVALUATION QUESTIONNAIRE

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, at *this* moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.	Almost Never	Sometimes	Often	Almost Always
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4

19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

State Trait Anxiety Inventory – Form Y-2 (Trait Inventory)
SELF-EVALUATION QUESTIONNAIRE

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel.	Almost Never	Sometimes	Often	Almost Always
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I feel like a failure	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected"	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I have disturbing thoughts	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I make decisions easily	1	2	3	4
35. I feel inadequate	1	2	3	4
36. I am content	1	2	3	4

37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

Appendix K

Difficulties in Emotion Regulation Scale

Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item:

1-------------------------2-------------------------3-------------------------4-------------------------5

almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)

______ 1) I am clear about my feelings.

______ 2) I pay attention to how I feel.

______ 3) I experience my emotions as overwhelming and out of control.

______ 4) I have no idea how I am feeling.

______ 5) I have difficulty making sense out of my feelings.

______ 6) I am attentive to my feelings.

______ 7) I know exactly how I am feeling.

______ 8) I care about what I am feeling.

______ 9) I am confused about how I feel.

______ 10) When I'm upset, I acknowledge my emotions.

______ 11) When I'm upset, I become angry with myself for feeling that way.

______ 12) When I'm upset, I become embarrassed for feeling that way.

______ 13) When I'm upset, I have difficulty getting work done.

______ 14) When I'm upset, I become out of control.

______ 15) When I'm upset, I believe that I will remain that way for a long time.

______ 16) When I'm upset, I believe that I'll end up feeling very depressed.

______ 17) When I'm upset, I believe that my feelings are valid and important.

______ 18) When I'm upset, I have difficulty focusing on other things.

______ 19) When I'm upset, I feel out of control.

______ 20) When I'm upset, I can still get things done.

______ 21) When I'm upset, I feel ashamed with myself for feeling that way.

1-------------------------2-------------------------3-------------------------4-------------------------5

almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)

_____ 22) When I'm upset, I know that I can find a way to eventually feel better.

_____ 23) When I'm upset, I feel like I am weak.

_____ 24) When I'm upset, I feel like I can remain in control of my behaviors.

_____ 25) When I'm upset, I feel guilty for feeling that way.

_____ 26) When I'm upset, I have difficulty concentrating.

_____ 27) When I'm upset, I have difficulty controlling my behaviors.

_____ 28) When I'm upset, I believe that there is nothing I can do to make myself feel better.

_____ 29) When I'm upset, I become irritated with myself for feeling that way.

_____ 30) When I'm upset, I start to feel very bad about myself.

_____ 31) When I'm upset, I believe that wallowing in it is all I can do.

_____ 32) When I'm upset, I lose control over my behaviors.

_____ 33) When I'm upset, I have difficulty thinking about anything else.

_____ 34) When I'm upset, I take time to figure out what I'm really feeling.

_____ 35) When I'm upset, it takes me a long time to feel better.

_____ 36) When I'm upset, my emotions feel overwhelming.

Appendix L

Rumination Reflection Questionnaire

Instructions:

For each of the statements located on the next two pages, please indicate your level of agreement or disagreement by circling one of the scale categories to the right of each statement. Use the scale as shown below:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	**2**	**3**	**4**	**5**

1.	My attention is often focused on aspects of myself I wish I'd stop thinking about.	1	2	3	4	5
2.	I always seem to be "re-hashing" in my mind recent things I've said or done.	1	2	3	4	5
3.	Sometimes it is hard for me to shut off thoughts about myself.	1	2	3	4	5
4.	Long after an argument or disagreement is over with, my thoughts keep going back to what happened	1	2	3	4	5
5.	I tend to "ruminate" or dwell over things that happen to me for a really long time afterward.	1	2	3	4	5
6.	I don't waste time re-thinking things that are over and done with.	1	2	3	4	5
7.	Often I'm playing back over in my mind how I acted in a past situation	1	2	3	4	5
8.	I often find myself re-evaluating something I've done.	1	2	3	4	5
9.	I never ruminate or dwell on myself for very long	1	2	3	4	5
10.	It is easy for me to put unwanted thoughts out of my mind.	1	2	3	4	5
11.	I often reflect on episodes in my life that I should no longer concern myself with.	1	2	3	4	5
12.	I spend a great deal of time thinking back over my embarrassing or disappointing moments.	1	2	3	4	5
13.	Philosophical or abstract thinking doesn't appeal to me that much.	1	2	3	4	5
14.	I'm not really a meditative type of person.	1	2	3	4	5
15.	I love exploring my "inner" self.	1	2	3	4	5
16.	My attitudes and feelings about things fascinate me.	1	2	3	4	5
17.	I don't really care for introspective or self-reflective thinking.	1	2	3	4	5
18.	I love analyzing why I do things.	1	2	3	4	5
19.	People often say I'm a "deep", introspective type of person.	1	2	3	4	5
20.	I don't care much for self-analysis.	1	2	3	4	5
21.	I'm very self-inquisitive by nature	1	2	3	4	5
22.	I love to meditate on the nature and meaning of things.	1	2	3	4	5
23.	I often love to look at my life in philosophical ways.	1	2	3	4	5
24.	Contemplating myself isn't my idea of fun.	1	2	3	4	5

Appendix M

Perceived Stress Scale

Instructions: The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.	Never	Almost Never	Sometimes	Fairly Often	Very Often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Appendix N

Academic Coping Strategies Scale

Everyone deals with stressful situations or problems from time to time. The items below represent some possible strategies people may use to deal with problems or stressful situations. As you respond to the following set of items, please respond based on how you have reacted when faced with the following problem situation:

Think about a time when you received a low grade on an important exam, significantly lower than what you usually get.

On the items below, please rate how often you have used the following strategies when faced with the situation described above, by circling one of the numbers to the right of each item.

	How often do you use this strategy?				
1. Creating a specific plan of action for solving the problem	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
2. Being persistent in trying to solve or fix the problem	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
3. Doing nothing about the problem	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
4. Asking questions about the problem	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
5. Talking to a professor / supervisor for emotional support	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				

6. Expressing your emotions to someone	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
7. Accepting that you can't do anything about the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
8. Trying to gain control over the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
9. Trying to learn from your mistakes	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
10. Talking to a friend from outside school, or a family member, for specific advice on how to solve the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
11. Trying to find out what you did wrong	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
12. Denying that the problem exists	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
13. Trying to avoid thinking about the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
14. Talking to another student for specific advice on how to solve the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				

15. Setting specific goals for solving the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
16. Hoping the problem will fix itself	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
17. Brainstorming a variety of possible solutions to the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
18. Telling yourself the problem isn't that important	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
19. Ignoring the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
20. Thinking positively about the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
21. Talking to another student for emotional support	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
22. Wishing you were more capable of dealing with the problem situation	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always
	How often do you use this strategy?				
23. Drawing on your past experiences to help you solve the problem	1 Never	2 Hardly Ever	3 Sometimes	4 Often	5 Almost Always

	How often do you use this strategy?				
24. Leaving the problem situation altogether	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
25. Putting forth more effort into developing skills to master the problem	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
26. Engaging in activities to distract you from the problem (reading, watching a movie, watching TV, listening to music)	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
27. Expressing your emotions by crying	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
28. Trying to learn something from the experience	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
29. Working hard to solve the problem	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
30. Trying to think about the problem carefully before acting	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				
31. Withdrawing from other people	**1**	**2**	**3**	**4**	**5**
	Never	**Hardly Ever**	**Sometimes**	**Often**	**Almost Always**
	How often do you use this strategy?				

32. Talking to a friend from outside school, or a family member, for emotional support	**1** **Never**	**2** **Hardly Ever**	**3** **Sometimes**	**4** **Often**	**5** **Almost Always**
	How often do you use this strategy?				
33. Gathering additional information about the problem, finding out more about the problem	**1** **Never**	**2** **Hardly Ever**	**3** **Sometimes**	**4** **Often**	**5** **Almost Always**
	How often do you use this strategy?				
34. Getting other peoples' perspective of the problem	**1** **Never**	**2** **Hardly Ever**	**3** **Sometimes**	**4** **Often**	**5** **Almost Always**

Appendix O

Social Provisions Scale

Next I'm going to ask you about your relationship with other people. Please tell me how much each statement describes your situation by using these responses." *[Hand answer card and read responses.]* **"So, for example, if you feel a statement is VERY TRUE you would say Strongly Agree. If you feel a statement CLEARLY does not describe your relationships, you would answer Strongly Disagree. Do you have any questions?"**

	Strongly Disagree	Disagree	Agree	Strongly Agree	R
1. There are people I know will help me if I really need it.	1	2	3	4	R
2. I do not have close relationships with other people.	1	2	3	4	R
3. There is no one I can turn to in times of stress.	1	2	3	4	R
4. There are people who call on me to help them.	1	2	3	4	R
5. There are people who like the same social activities I do.	1	2	3	4	R
6. Other people do not think I am good at what I do.	1	2	3	4	R
7. I feel responsible for taking care of someone else.	1	2	3	4	R
8. I am with a group of people who think the same way I do about things.	1	2	3	4	R
9. I do not think that other people respect what I do.	1	2	3	4	R
10. If something went wrong, no one would help me.	1	2	3	4	R
11. I have close relationships that make me feel good.	1	2	3	4	R

12. I have someone to talk to about decisions in mv life.	**1**	**2**	**3**	**4**	**R**
	Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**	
13. There are people who value my skills and abilities.	**1**	**2**	**3**	**4**	**R**
14. There is no one who has the same interests and concerns as me.	**1**	**2**	**3**	**4**	**R**
15. There is no one who needs me to take care of them.	**1**	**2**	**3**	**4**	**R**
16. I have a trustworthy person to turn to if	**1**	**2**	**3**	**4**	**R**
17. I feel a strong emotional tie with at least one other person.	**1**	**2**	**3**	**4**	**R**
18. There is no one I can count on for help if I really need it.	**1**	**2**	**3**	**4**	**R**
19. There is no one I feel comfortable talking about problems with.	**1**	**2**	**3**	**4**	**R**
20. There are people who admire my talents and abilities.	**1**	**2**	**3**	**4**	**R**
21. I do not have a feeling of closeness with anyone.	**1**	**2**	**3**	**4**	**R**
22. There is no one who likes to do the things	**1**	**2**	**3**	**4**	**R**
23. There are people I can count on in an emergency.	**1**	**2**	**3**	**4**	**R**
24. No one needs me to take care of them.	**1**	**2**	**3**	**4**	**R**

Appendix P (BFI-44)

How I am in general

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please write a number next to each statement to indicate the extent to which **you agree or disagree with that statement.**

1	2	3	4	5
Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly

I am someone who…

1. _____ Is talkative
2. _____ Tends to find fault with others
3. _____ Does a thorough job
4. _____ Is depressed, blue
5. _____ Is original, comes up with new ideas
6. _____ Is reserved
7. _____ Is helpful and unselfish with others
8. _____ Can be somewhat careless
9. _____ Is relaxed, handles stress well.
10. _____ Is curious about many different things
11. _____ Is full of energy
12. _____ Starts quarrels with others
13. _____ Is a reliable worker
14. _____ Can be tense
15. _____ Is ingenious, a deep thinker
16. _____ Generates a lot of enthusiasm
17. _____ Has a forgiving nature
18. _____ Tends to be disorganized
19. _____ Worries a lot
20. _____ Has an active imagination
21. _____ Tends to be quiet
22. _____ Is generally trusting
23. _____ Tends to be lazy
24. _____ Is emotionally stable, not easily upset
25. _____ Is inventive
26. _____ Has an assertive personality
27. _____ Can be cold and aloof
28. _____ Perseveres until the task is finished
29. _____ Can be moody
30. _____ Values artistic, aesthetic experiences

31. _____ Is sometimes shy, inhibited

32. _____ Is considerate and kind to almost everyone

33. _____ Does things efficiently

34. _____ Remains calm in tense situations

35. _____ Prefers work that is routine

36. _____ Is outgoing, sociable

37. _____ Is sometimes rude to others

38. _____ Makes plans and follows through with them

39. _____ Gets nervous easily

40. _____ Likes to reflect, play with ideas

41. _____ Has few artistic interests

42. _____ Likes to cooperate with others

43. _____ Is easily distracted

44. _____ Is sophisticated in art, music, or liter

Appendix Q

College Self-Efficacy Inventory

Instructions: Think about yourself as a university student. For each statement below, circle the number that best represents your confidence. How confident are you that you could successfully complete the following tasks: (Circle <u>one</u> number)	Totally Unconfident	Very Unconfident	Unconfident	Somewhat Unconfident	Undecided	Somewhat Confident	Confident	Very Confident	Totally Confident
1. Make new friends a university	0	1	2	3	4	5	6	7	8
2. Talk to your professors/instructors	0	1	2	3	4	5	6	7	8
3. Take good class notes	0	1	2	3	4	5	6	7	8
4. Divide chores with others you live with	0	1	2	3	4	5	6	7	8
5. Research a term paper	0	1	2	3	4	5	6	7	8
6. Understand your textbooks	0	1	2	3	4	5	6	7	8
7. Get a date when you want one	0	1	2	3	4	5	6	7	8
8. Ask a professor or instructor a question outside of class	0	1	2	3	4	5	6	7	8
9. Get along with others you live with	0	1	2	3	4	5	6	7	8
10. Write a course paper	0	1	2	3	4	5	6	7	8
11. Socialize with others you live with	0	1	2	3	4	5	6	7	8
12. Do well on your exams	0	1	2	3	4	5	6	7	8
13. Talk with a school academic and support staff	0	1	2	3	4	5	6	7	8
14. Manage your time effectively	0	1	2	3	4	5	6	7	8
15. Join a student organization	0	1	2	3	4	5	6	7	8
16. Ask a question in class	0	1	2	3	4	5	6	7	8

17. Divide space in your residence (if applicable)	0	1	2	3	4	5	6	7	8
18. Participate in class discussions	0	1	2	3	4	5	6	7	8
19. Keep up to date with your schoolwork	0	1	2	3	4	5	6	7	8

Directions: How much confidence do you have about doing each of the behaviours listed below? For each statement below, circle the letter that best represents your confidence.

Quite a lot				Very little	
A	B	C	D	E	1.Taking well-organized notes during lecture
A	B	C	D	E	2. Participating in a class discussion
A	B	C	D	E	3. Answering a question in a large class
A	B	C	D	E	4. Answering a question in a small class
A	B	C	D	E	5. Taking "objective" tests (multiple choice, T-F, matching))
A	B	C	D	E	6. Taking essay tests
A	B	C	D	E	7. Writing a high-quality term paper
A	B	C	D	E	8. Listening carefully during a lecture on a difficult topic
A	B	C	D	E	9. Tutoring another student
A	B	C	D	E	10. Explaining a concept to another student.
A	B	C	D	E	11. Asking a professor in class to review a concept you don't understand
A	B	C	D	E	12. Earning good marks in most courses.
A	B	C	D	E	13. Studying enough to understand content thoroughly.
A	B	C	D	E	14. Running for student government office.

A	B	C	D	E	15. Participating in extracurricular events (sports, clubs)
A	B	C	D	E	16. Making professors respect you.
A	B	C	D	E	17. Attending class regularly.
A	B	C	D	E	18. Attending class consistently in a dull course.
A	B	C	D	E	19. Making a professor think you're paying attention in class.
A	B	C	D	E	20. Understanding most ideas you read in your tests.
A	B	C	D	E	21. Understanding most ideas presented in class.
A	B	C	D	E	22. Performing simple math computations.
A	B	C	D	E	23. Using a computer.
A	B	C	D	E	24. Mastering most content in a math course.
A	B	C	D	E	25. Talking to a professor privately to get to know him or her.
A	B	C	D	E	26. Relating course content to material in other courses.
A	B	C	D	E	27. Challenging a professor's opinion in class.
A	B	C	D	E	28. Applying lecture content to a laboratory session.
A	B	C	D	E	29. Making good use of the library.
A	B	C	D	E	30. Getting good grades.
A	B	C	D	E	31. Spreading out studying instead of cramming.
A	B	C	D	E	32. Understanding difficult passages in textbooks.
A	B	C	D	E	33. Mastering content in a course you're not interested in.

Vita Auctoris

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