AWARENESS, ACCEPTANCE, AND EQUANIMITY: RELATIONSHIPS BETWEEN TRAIT MINDFULNESS, STRESS, AND BLOOD PRESSURE

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AWARENESS, ACCEPTANCE, AND EQUANIMITY: RELATIONSHIPS BETWEEN TRAIT MINDFULNESS, STRESS, AND BLOOD PRESSURE

by

Gabrielle R. Chin

A Dissertation

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Dedications

I dedicate this document to the good boys who I have journeyed alongside:

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Abstract

Gabrielle Chin
AWARENESS, ACCEPTANCE, AND EQUANIMITY: RELATIONSHIPS BETWEEN TRAIT MINDFULNESS, STRESS, AND BLOOD PRESSURE
2022-2023
Jeffrey Greason, Ph.D.
Doctor of Philosophy

Hypertension (HTN) is associated with stress and unhealthy emotion regulation. Mindfulness-based interventions (MBIs) are said to help address stress-related diseases like cardiovascular disease by impacting stress and emotion regulation, yet studies of MBIs on cardiovascular health show inconsistent findings. Limited research has examined the basic links between trait mindfulness and cardiovascular health, leaving the active components of MBIs in this context unclear. Therefore, the current study examined the relationship between trait mindfulness and blood pressure (BP) in individuals with pre-hypertension (pre-HTN). Latent variables representing two conceptualizations of trait mindfulness - Monitor and Accept Theory (MAT) and Equanimity - were calculated using facets of the Five Facet Mindfulness Questionnaire (FFMQ), and their relationships with BP tested (n=296) using structural equation modeling and moderated multiple regression. Higher equanimity associated with higher BP at a level not reaching clinical relevance, and this relationship was not moderated by stress or mediated by rumination or suppression. Trait mindfulness as described in MAT did not predict lower SBP or DBP. Validity concerns regarding the FFMQ, and the state of the mindfulness research field are discussed in relation to the current study results. Subsequent recommendations for improving trait mindfulness measurement are described.
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Chapter 1

Introduction

Stress and stress-related diseases are rising in prevalence. However, mindfulness may provide support in managing the effects of stress-related diseases. In the United States, both the average number of stressors per person and overall reported stress is increasing (American Psychological Association, 2015; American Psychological Association, 2017; American Psychological Association, 2020). The ongoing COVID-19 pandemic presents a chronic stressor, generating heightened stress in many countries (Gloster et al., 2020; Manchia et al., 2022). Stress, and subsequent maladaptive emotional responses to stressors, are well-recognized as primary psychological factors generating allostatic load and driving hypertension (HTN). Having HTN is a primary risk factor for cardiovascular disease (CVD), the leading cause of death globally (Fuchs & Whelton, 2020; Kannel, 2000; McNamara et al., 2019). Currently, at least half of American adults have some form of elevated blood pressure (BP). This includes both pre-HTN, or systolic blood pressure (SBP) of 120-139 mmHg and/or diastolic blood pressure (DBP) of 80-89 mmHg, and frank HTN, with SBP reaching or exceeding 140 mmHg and DBP reaching or exceeding 90 mmHg (Egan & Farby, 2015; Centers for Disease Control and Prevention, 2021).

Mindfulness, and mindfulness-based interventions (MBIs), are empirically supported methods for reducing stress and may help improve HTN. The current study examined baseline, cross-sectional data from the Serenity Study, a recently completed multisite randomized clinical trial examining if Mindfulness-Based Stress Reduction (MBSR) training reduces BP in participants with pre-HTN. The following chapters of
this document describe the biology of BP and stress, including allostatic load, discuss two forms of emotion regulation relating to stress, BP, and allostatic load, and illustrate two hypothetical ways mindfulness, as a dispositional trait, may impact stress and BP. Then, the dissertation rationale, aims, methods, results, and relevance of results to the field of mindfulness research will be discussed.

The objectives of this dissertation include (1) extending our understanding of how mindfulness, conceptualized both as the interaction of mindful awareness and acceptance posed in Monitor and Accept Theory (MAT), and as equanimity from a Buddhist framework, relate to BP; and (2) investigating if or to what degree stress and emotion regulation strategies moderate and mediate these relationships, respectively. The research questions were as follows: (1) Does higher equanimity predict lower BP, and does the strength of this relationship vary across levels of stress, such that at higher stress, the relationship is stronger? (2) To what degree is the purported relationship between equanimity and BP explained by rumination and suppression? (3) To what degree does the interaction of mindful awareness and acceptance described in MAT predict BP?

**Blood Pressure and Stress**

BP, measured in millimeters mercury (mm Hg), describes the pressure physically exerted by blood against the walls of the cardiovascular system during the body’s cardiovascular circulatory process (Kasper et al., 2015). Many factors are known to increase BP, and thereby CVD risk. Aside from biological vulnerability, factors such as race, genetics, family history of CVD (Knowles & Ashely, 2018), environmental factors like socioeconomic status (SES), and even temperature, ambient noise, and organic
pollutant levels, increase BP (Brook et al., 2011). Still, these well-established factors explain less than half of the total variance when predicting actual CVD onset (Futterman & Lemberg, 1998). Recent studies attempting to identify the factors accounting for this remaining variance primarily have examined psychological variables linking affective experiences and emotion regulation with cardiovascular outcomes (Chida & Steptoe, 2009). Although the exact causal mechanisms of HTN remain uncertain, substantial research evinces the fundamental contribution of psychological factors, primarily stress, to HTN development (Mulle & Vaccarino, 2018).

Chiefly defined as “the adaptational problems imposed by difficult conditions of life” (Lazarus & Folkman, 1984), stress conceptually unites the plethoric unavoidable human experiences to which adaptation is difficult. In short, stress occurs when an individual’s adaptational needs are greater than their available coping resources. Stress can be both short-term (acute stress) and longer-term (chronic stress). Stress directly contributes to biological development of HTN, and indirectly contributes to, influences, and is influenced by other behavioral, biological, and environmental factors associated with HTN (Spruill, 2010; Gordon & Mendes, 2021). Both acute and chronic stress are associated with HTN and increased risk of CVD. Longer exposure to stress and stronger emotional and physiological responses to stress are positively associated with increased HTN and CVD risk (Light et al., 1999; Spruill, 2010). Three primary factors determine if stressors compromise health: biological vulnerability, the frequency and persistence of the stressor, and stress coping methods (Schneiderman, Ironson & Siegel, 2005).
**Biology of Stress**

Allostasis is the balance and dynamic regulation of sympathetic and parasympathetic nervous system activation, allowing bodily systems to appropriately adapt to stress (McEwen, 1998; McEwen & Wingfield, 2003). Biologically, stress triggers responses within the body to achieve allostasis. Within the cardiovascular system, achieving allostasis involves the secretion of catecholamines from the adrenal glands, increasing blood vessel constriction and raising both heart rate and BP. These cardiovascular responses facilitate movement of endocrine hormones necessary for allostatic responses of other bodily systems through the bloodstream, allowing for increased bodily expenditure necessary for behavioral acute stress responses (e.g., fight or flight response).
Note. Figure 1 depicts the pathways by which chronic stress leads to allostatic load, and eventual allostatic overload that predisposes to disease, including high BP and CVD. Figure modified from Karatsoreos, I. N., & McEwen, B. S. (2010). Stress and allostasis. *Handbook of behavioral medicine: Methods and applications*, 649-658.

Short term, these sympathetic responses generally maintain health. As part of allostasis, following an elevated sympathetic nervous system response, the parasympathetic nervous system typically secretes acetylcholine, counteracting effects of sympathetic activation and restoring homeostasis. However, in individuals with
ineffective baseline allostatic stress responses, and/or with chronic stress and the
tendency to utilize emotion regulation strategies which intensify, lengthen, and increase
the frequency of these responses, stress generates cumulative damage to bodily systems
via allostatic load (McEwen, 2000; Ottaviani et al., 2016; Guidi et al., 2021).

As allostatic load builds, typical sympathetic nervous system stress responses
become increasingly active, eventually leading to a state termed allostatic overload.
Allostatic overload refers to the constant overactivation of the sympathetic nervous
system and subsequent inability to achieve homeostasis via parasympathetic nervous
system activation. ‘Wear and tear’ damage associated with allostatic load and eventual
allostatic overload accumulates over the lifetime, and cyclically induces further stress-
related symptoms and illnesses (McEwen, 2000; Lagraauw, Kuiper & Bot, 2015; Guidi et
al., 2020).

Within the cardiovascular system, allostatic overload results in higher resting
arterial blood flow and BP. Over time, allostatic overload will spur development of
cardiovascular preclinical pathology like enlarged musculature of the heart, increased
blood thickness due to higher platelet levels, and arterial and ventricular hardening. These
conditions contribute to arterial tissue damage, blockage, and rupture. Taken together,
effects of allostatic overload increase the risk of CVD. A systematic review of 267
studies indicates in individuals with HTN and/or CVD, emotional and psychological
stress and distress characterizes allostatic load. In this review, higher allostatic load
predicted lower levels of wellbeing, poorer quality of life, and worse intervention and
disease outcomes (Guidi et al., 2021).
While biomarkers of stress-related diseases are generally considered tertiary indicators of allostatic overload, these BP-related effects are so well-evinced that high resting BP is considered a secondary indicator, with the only stronger indicators being elevated adrenal hormone levels (Guidi et al., 2021). Through allostatic load, stress contributes to an estimated 54% of stroke and 47% of ischemic heart disease events (Lawes, Hoorn & Rodgers, 2008; Peters, McEwen & Friston, 2017). It is estimated that HTN independently contributes to an alarming 18% of premature global death (Campbell et al, 2015). The slow-to-present yet cumulatively severe effects of chronic stress on BP explain why HTN, the ‘silent killer’, is dually considered a primary risk factor of cardiovascular disease (CVD) incidence and a CVD itself (Kalehoff et al., 2020).

**Emotion Regulation**

Among American adults, average stress continues to rise, alongside effects of stress on health, like HTN and CVD (American Psychological Association, 2020; Zhou et al., 2021). The most stressful life events are relatively common. For example, as measured by the gold-standard Holmes and Rahe Stress Scale, some of the most stressful life events are death of a spouse or close family member, divorce or separation, imprisonment, or personal injury and illness (Noone et al., 2017). Stressful situations like these generate emotional responses, such as anxiety, sadness, anger, and fear. The management of these responses is called emotion regulation (Gross, 2002; Gross, 2014). Emotion regulation encapsulates management of both pleasurable and aversive emotions, with different emotion regulation strategies learned and shaped through the life course.
As a result, individuals naturally vary in their utilization of emotion regulation strategies to manage their inherently differing emotional experiences (Gross, 2014).

Different emotion regulation strategies can positively or negatively impact the physiological stress response process (Trudel-Fitzgerald et al., 2015). Emotion regulation strategies generally fall into one of two categories—antecedent focused or response focused, which differ based upon the time they are utilized during emotion management (Gross, 1998). Antecedent-focused strategies involve altering emotion-eliciting events or cognitively altering one’s perception of said event prior to the emotion being fully consciously experienced (Gross, 1998). In comparison, response-focused strategies involve attempts to alter an emotion, or one’s response to said emotion, during or after the emotion is already wholly occurring within consciousness (Gross, 1998).

**Stress and Emotion Regulation**

Stress can impair an individual’s ability to regulate their own behavior, thereby undermining their capacity to marshal more effective emotion regulation strategies like problem-solving, situation selection, changes in attentional deployment, or cognitive reappraisal (Gross, 1998; Gross, 2002). Akin to how stress can affect the cardiovascular system through allostatic load, stress-generated adrenal hormones over time reduce gray matter volume in the hippocampus, prefrontal cortex, amygdala, anterior cingulate cortex, left medial temporal lobe, and right superior frontal lobe (McEwen et al., 2016; Arnsten, 2009; Ansell et al., 2012; Li et al., 2014). These areas are critically involved in learning and memory, attention control, managing goal-directed behavior, and emotion processing (Garett & Hough, 2017). As stress structurally impacts these key regions of the brain,
each of these complex processes may be altered due to chronic stress. This may result in impaired ability to regulate behavior, including emotion regulation processes (McEwen & Gianaros, 2010; Garett & Hough, 2017).

Aside from directly affecting BP and CVD risk via allostatic load, stress and resultant emotions can promote use of ineffective emotion regulation strategies, which directly and indirectly further increase allostatic load, BP, and CVD risk. (Larsen & Christenfield, 2009; Quartana & Burns, 2010; Gross, 2014; Peters, 2014; Patel & Patel, 2019). Emotion regulation strategies which lengthen and/or strengthen the cardiovascular stress response generate greater allostatic load, thus worsening negative cardiovascular health effects. Although prolonged sympathetic nervous system activity is suggested to be especially damaging compared with shorter but stronger stress responses, both generate allostatic load and damage cardiovascular health (Glynn et al., 2002). Two response-focused emotion regulation strategies-- Rumination and expressive suppression—prolong and/or strengthen BP responses to stress, evidencing well-demonstrated relationships with stress and BP (Nolen-Hoeksema, 1991; Peters, Overall & Jamieson, 2014; Michl, McLaughlin, Shepard & Nolen-Hoeksema, 2013).
Figure 2

*Representation of Effects of Rumination and Suppression on Physiological Responding*

*Note.* Figure 2 represents how two different maladaptive styles of emotion regulation can heighten and prolong physiological responses to stress, like BP. Response duration before return to baseline is pictured on the x-axis, while the magnitude of the response is pictured on the y-axis. Generic rumination, suppression, and normative response curves are conveyed using the dotted lines. As pictured, rumination intensifies initial emotional and physiological stress reactivity, and lengthens recovery. Suppression requires continual cognitive effort to maintain, increasing sympathetic nervous system responding over time, and lengthening recovery from stress. Although not pictured here, rumination and suppression can occur repeatedly in reaction to a single stressor, contributing additional allostatic load and advancing pathological states. Modified from Moving
Rumination

Rumination is the act of repetitive thinking about negative events or negative mood states (Nolen-Hoeksema et al., 2008). Rumination is typically measured using self-report questionnaires assessing an individual’s dispositional tendency to engage in rumination to regulate distressful emotions (Smith & Alloy, 2009). According to the Response Styles and Control theories of rumination, it is an ineffective emotion regulation strategy which occurs when stressful events highlight any discrepancies between an individual’s goals and their actual state, leading to abstract and evaluative thoughts on said events (Nolen-Hoeksema, 1991; Watkins, 2008). Although rumination may occur as an attempt to reconcile these discrepancies and associated negative mood states, it fails to achieve this goal (Lyubomirsky et al., 2015). In the absence of any environmental context necessitating this focus, the ineffective focus on past negative events or mood states and their presumed causes and effects characterizes rumination, distinguishing it from worry (Watkins et al., 2005, Fresco et al., 2002). Rumination can begin as an effortful attempt to improve an individual’s understanding of a stressor. However, over time, it can become a pathological, habitual response to stress (Lazarus & Folkman, 1984).
**Rumination, Stress, and Blood Pressure**

The experience of negative emotions can independently give rise to sympathetic nervous system activity, associated cardiovascular stress responses, and allostatic load, even apart from harmful emotion regulation strategies. Each of these cardiovascular stress responses generates ‘wear and tear’ damage on the cardiovascular system, contributing to eventual allostatic overload, HTN, and CVD risk. However, ruminating heightens and prolongs the cardiovascular stress response process (see Figure 2, top curve). As described by the preservative cognition hypothesis, stress negatively affects health when stressors are thought about continuously or repetitively (e.g., ruminated upon) (Brosschot et al., 2005). Although the stressful event itself may be short, rumination about said stressor occurs following the event, potentially repeatedly and far into the future. The cardiovascular system reacts to each of these perseverative thoughts, generating allostatic load independently of the actual stressful event itself. This increases the total time a single stressful event may ultimately damage bodily systems, leading to HTN and other stress-related diseases (Brosschot et al., 2005; Brosschot et al., 2010).

Moreover, rumination increases the perceived importance an individual may place upon stressful events, heightening emotional reactivity to a stressor, and thereby strengthening and lengthening subsequent cardiovascular responses to rumination on said stressor (Watkins, Moberly & Moulds, 2008; Busch et al., 2017).

Because of this repeated, strengthened, and prolonged activation of cardiovascular sympathetic responses, the act of rumination is a key mechanism of the stress-disease link (Glynn et al., 2002; Brosschot et al., 2005; Lovallo, 2010). Multiple studies have
demonstrated this link. A meta-analysis of 43 studies evaluating cardiovascular responses to rumination showed induced rumination elicited significantly heightened SBP and DBP reactivity, and lengthened SBP recovery. The authors suggest that over time, the repeated cardiovascular responses could contribute to autonomic dysregulation and allostatic load (Busch et al., 2017). Similar results have been observed in studies of trait rumination. One study found individuals with higher trait rumination scores exhibited prolonged BP responses to an anger recall task (Gerin et al., 2006), while cross-sectional studies demonstrate a link between higher trait rumination, clinic BP (Hogan & Linden, 2004) and ambulatory BP (Oseitutu et al., 2001).

Expressive Suppression

Expressive suppression is the conscious, effortful inhibition of reflexive outward displays of emotion, despite ongoing inward emotional responses to emotion eliciting events (Gross & Levenson, 1993; Moore et al., 2008). Suppression is commonly measured via an individual’s dispositional tendency towards or against habitually selecting suppression to regulate emotions and is often captured via self-report questionnaires. The Emotion Regulation Questionnaire is widely considered the gold-standard measure of suppression (Gross & John, 2003).

Although suppression may at times be adaptive, the dispositional tendency to engage in suppression may be key in developing HTN (Suls et al., 1995; Jorgensen et al., 1996), specifically the suppression of impulses generated from anger and stress (Cottington et al., 1986; Hosseini et al., 2011). As suppression typically fails to modulate internal negative emotional experiences, it does not fully ameliorate sympathetic and
cardiovascular stress responses to the emotion being suppressed from outward responding. Given it does not modify either emotional or biological responses to stress, suppression requires intensive and continuous cognitive exertion to maintain (Richards, 2004). This continual mental effort causes further stress, strengthening extant sympathetic cardiovascular stress responses to the internal emotional experience, and generating further allostatic load, which can raise BP.

Suppression also often necessitates repeated or frequent effortful attempts to successfully modulate outward affect throughout the duration of a single given event, particularly in the context of emotions like anger and hostility (Richards, 2004; Cutuli, 2014). Even within a single suppression-soliciting event, these continual attempts to successfully suppress one’s affect generate additional stress, likely further strengthening and prolonging cardiovascular stress responses. This combination of stressful cognitive effort needed for achieving and maintaining suppression, alongside suppression’s inability to effectively resolve negative emotions, results in stronger and lengthened sympathetic cardiovascular stress responses. Cumulatively, these responses worsen allostatic load, inciting HTN and CVD (Cutuli, 2014; Giese-Davis et al., 2008; Guidi et al., 2021).

Studies indicate the tendency towards engaging in suppression, versus antecedent-focused emotion regulation strategies, associates with multiple negative cardiovascular factors and outcomes. For example, when compared with cognitive reappraisal, studies show higher trait suppression more strongly associates with higher BP (Memedovic et al., 2010), higher engagement in behavioral cardiovascular disease risk factors, elevated
prospective cardiovascular disease risk (Appleton et al., 2014), and poorer cardiovascular
disease outcomes (Harburg et al., 2003; Mauss et al., 2004). Altogether, much like
rumination, consistent use of suppression may generate allostatic load, thereby
engendering negative effects on cardiovascular health and worsening CVD outcomes
(Gross, 1998b; Gross & Levenson, 1997; Harris, 2001; Appleton et al., 2014).

**Stress, Emotion Regulation, and Blood Pressure**

Taken together, findings to date indicate chronic engagement in rumination and
suppression are key pieces within the stress-disease link. Rumination and suppression
directly mechanistically relate to BP and allostatic load, and may indirectly impact
various behaviors associated with cardiovascular disease development. Through these
pathways, stress, suppression, and rumination can incite HTN and CVD. The tendency to
use a particular emotion regulation strategy is shaped by life experiences, with
subsequent natural variation across individuals and time. Tendency towards certain
emotion regulation strategies can therefore also be impacted by purposeful intervention.
Thus, these concepts or interventions relating to or impacting cardiovascular health
should likely also affect emotion regulation, by possibly lowering or decreasing
engagement in ineffective emotion regulation strategies, like rumination or suppression.
Exploring the links between these emotion regulation strategies and objective
cardiovascular disease risk factors like BP, may inform future forms of CVD prevention
and intervention. To minimize the rising risk of stress-related diseases like HTN, stress
must be somehow managed (Regus, 2014). The universality of stress, the potency of
stress as a risk factor for HTN, and the ubiquity of HTN, highlight the need for research
on factors interceding across the continuum of stress and disease. One such factor is mindfulness.

**Mindfulness**

Mindfulness practices are heralded as innovative, non-pharmacologic, and cost-effective methods of stress reduction. One recent national survey shows that 12% of Americans report using mindfulness techniques to reduce stress (Herman et al., 2017; Kabat-Zinn, 1979; American Psychological Association, 2017). Given the considerable evidence linking mindfulness with reduced stress and bolstered well-being, and the rising reports of stress and stress-related diseases across the globe, this prevalence of use is unsurprising (Greeson & Chin, 2019; Regus, 2014). As a term, mindfulness broadly describes the family of techniques, processes, and characteristics relating to the generation of insight, awareness, and acceptance derived from Buddhist teachings (Shapiro et al., 2005; Chambers et al., 2009; Van Dam et al., 2018). A common operational definition of mindfulness utilized in mindfulness research is “nonjudgmental awareness of the present moment experience” (Kabat-Zinn, 1982). However, other definitions exist.

For example, Desbordes et al. (2015) identified a nonsecular definition of mindfulness, drawn particularly from the Theravada tradition: “the quality of mind that one recollects continuously without forgetfulness or distraction while maintaining attention on a particular [mental] object.” Put simply, Desbordes et al. defined mindfulness as a state of purposeful meta-awareness of internal and external present moment experiences, or the process of purposefully sustaining attention upon an object
within working memory (Desbordes et al., 2015). Within more secular research literature, mindfulness has been characterized as “being aware of aspects of the mind itself…instead of being on automatic” (Siegel, 2007), as “paying attention in a way that creates space for insight” (American Public Media, 2015), as an “aware, balanced acceptance of the present experience” (Boorstein, 2014), and as an awareness introducing “a space between one’s perception and response” helping to regulate emotional responses versus changing the situation (Bishop et al, 2004).

Consequently, the ample variance in ways mindfulness is defined and utilized within the field of psychology has birthed numerous conceptualizations, assessments, and strategies for analysis of mindfulness within the psychological research context (Grossman & Van Dam, 2011). Alongside being conceptualized within research and practice as a state of balanced awareness and acceptance, mindfulness encompasses trainings targeting attention, awareness, and emotion regulation, and the inherent and naturally varying trait capacity of nonjudgmental awareness of and attention to the present moment.

**Mindfulness, Stress, and Blood Pressure**

Myriad studies demonstrate mindfulness-based interventions (MBIs) effectively decrease subjective measures of stress, with reductions in stress sustained over time (Martin-Asuero, 2010; Evans et al, 2011; Geary & Rosenthal, 2011; Bergen-Cico, Possemato & Cheon, 2013). Research on MBIs has advanced beyond examining modulation of stress in healthy individuals, exploring MBIs as an alternative or ancillary treatment for stress related diseases. Many studies show MBIs reduce stress and stress-
related symptoms across multiple stress-related diseases, including CVD (Fuchs & Whelton, 2020; Kannel, 2000; McNamara et al., 2019; Greeson & Chin, 2019). However, extant research on the effects of MBIs on objective metrics of cardiovascular health, like BP, shows mixed results (See pages 116-118 in the Discussion for further detail).

Compared with the numerous studies examining the effects of mindfulness interventions on objective measures of cardiovascular health, far fewer studies have investigated if trait mindfulness may relate to or benefit cardiovascular health. This is potentially problematic, as mindful states, trainings, and traits are interrelated (Shapiro et al., 2006). As trait mindfulness involves one’s tendency towards engagement in mindfulness in daily life, benefits of mindfulness trainings are hypothetically caused by increased trait mindfulness resulting from mindfulness training. Heightened trait mindfulness generates increased mindful states of consciousness, ultimately improving engagement in mindful behaviors throughout daily life. Yet, the hypothetical active components of MBIs within the cardiovascular context—essentially, the ways in which trait mindfulness may relate to cardiovascular health—remain relatively unestablished (Loucks et al., 2015).

The few studies to date investigating the mechanisms by which MBIs may benefit cardiovascular health do not appear to examine trait mindfulness. Furthermore, they show somewhat disparate results. Although both identified emotion regulation and attention control as active components, one thematic analysis additionally identified increased self-awareness as impacting emotion regulation and health behaviors (Nardi et al., 2020). The other identified perceived stress and interoceptive awareness as additional active
components, but not health behaviors (Loucks et al., 2019). Moreover, as these studies were both drawn from different focus groups in the same clinical trial, the robustness and ability of either of these results to replicate is uncertain (Loucks et al., 2019).

Although the mechanisms by which MBIs relate to cardiovascular health broadly are still unclear, the body of experimental research studies examining the effects of MBIs on cardiovascular health continues to grow (Greeson & Chin, 2019). Currently, more research is published on effects of MBIs within the cardiovascular context, than studies on trait mindfulness within the cardiovascular context (Ede et al., 2020). There is a discrepancy between relatively early conceptual understanding of mindfulness within the cardiovascular context, versus the comparatively advanced stage of the research literature (Heeren et al., 2021). As trait mindfulness hypothetically drives putative effects of MBIs on mind-body health, this discrepancy elucidates the importance of completing earlier stage research establishing basic correlational links between trait mindfulness, stress, behavior, and cardiovascular health.

**Trait Mindfulness**

As with how mindfulness itself can be conceptualized as a training, state, or trait, trait mindfulness is complex, conceptualized and assessed in the research literature in a multitude of ways. With over 9000 citations as of the writing of this chapter, one of the most prominent and widely accepted conceptualizations is the five-facet model of mindfulness developed by Baer et al. (2006). The five-facet model is noteworthy as it encapsulates multiple earlier prominent conceptualizations. Baer’s five-facet model divides mindfulness into five components: Observing, Describing, Nonjudging,
Nonreactivity, and Acting with Awareness (2008). Observing encapsulates paying attention to internal (thoughts, emotions, interoceptive bodily sensations) and external (auditory, olfactory, visible occurrences) experiences. Describing refers to the accurate cognitive labeling of internal experiences, particularly emotions. Nonjudging refers to the acceptance of internal experiences, and Nonreactivity refers to allowing internal experiences to occur and pass without having to react to them. Finally, Acting with Awareness refers to engaging fully in present-moment experiences (Baer et al., 2008).

**Trait Mindfulness in the Cardiovascular Context: Monitor and Accept Theory**

These various qualities comprising trait mindfulness are reflected in different behaviors and associated physiological response patterns relevant to BP and cardiovascular health in the context of daily life. In particular, these traits may serve to improve the tendency to rely on rumination or suppression to regulate one’s emotions, and subsequent physiological stress responses associated with allostatic load (Greeson, 2009; Hölzel et al., 2011; Shapiro et al. 2005; Loucks et al., 2015; Loucks et al., 2016). One recent and widely accepted conceptualization of how trait mindfulness relates to health is Monitor and Accept Theory (MAT). MAT posits in the context of high stress, the combination of awareness and acceptance can engender emotional, physical, and behavioral health benefits of mindfulness.

Lindsay and Creswell (2017) describe the central theory of MAT as 1) one’s skill in attention monitoring enhances their awareness of present-moment experience and is a mechanism by which mindfulness improves affective cognitive functioning outcomes and strengthens their affective experiences, in turn increasing both negative and positive
experiences; and 2) one’s skill in acceptance beneficially modifies relation to the present-moment experience, alongside reactivity to experiences. Within MAT, awareness is defined as the skill of using attention to accurately monitor the present moment, including both self-awareness of internal events and accurate awareness of external events. They state the construct of Observing from Baer’s five-facet model, which encapsulates paying attention to internal and external experiences in the present moment, corresponds to skill in attention monitoring (Lindsay & Creswell, 2017).

Lindsay and Creswell (2017) describe acceptance within MAT as the willing and open acceptance of all internal and external events regardless of valence, without the urge to engage in and extend pleasant experiences, or to avoid and shorten unpleasant experiences (Lindsay & Creswell, 2017). They additionally posit the five-facet model constructs of Nonjudging and Nonreactivity, which respectively refer to the acceptance of internal experiences, and allowing internal experiences to occur and pass without having to react, correspond with acceptance as it is conceptualized within MAT (Lindsay & Creswell, 2017).

Within MAT, a mindfully observant mindset may enable accurate appraisal of a stressor, its context, and of subsequent cognitive, emotional, and bodily reactions. Mindful self-awareness alongside acceptance of internal responses to the stressor may reduce physiological reactivity during stress. Cyclically, cultivating mindfulness as a response to stressors, including adaptive changes in cognitions, emotions, and physiological responses, may cause long-term improvements in cognitions and behaviors related to stress, modifying decision making regarding future utilization of emotion
regulation strategies (Garland, 2017). These hypothesized effects may allow the combination of mindful observing and acceptance to promote lower BP and better cardiovascular health (Creswell & Lindsay, 2014; Garland, 2017). This postulated interactive effect of awareness and acceptance affecting stress response and emotion regulation strategies differentiates MAT from other conceptualizations of trait mindfulness. This includes equanimity, another conceptualization of how trait mindfulness associates with health, which recently has found increased prominence in the mindfulness research literature.

**Equanimity**

The Buddhist philosophical tradition originated in India between 2400-2600 years ago based upon the teachings of Gautama Buddha (Conze, 1993). Over time, the Buddhist tradition has widely expanded, coming to encompass a plethora of disparate schools, beliefs, and practices. However, early Buddhist teachings present a construct called equanimity, both considered phenomenally distinct from mindfulness, and postulated to underlie it (Anālayo, 2021; Desbordes et al., 2015). In recent research literature attempting integration of Buddhist frameworks into the broader science of mindfulness, several authors have identified equanimity as the potential core mechanism by which mindfulness, as a trait or practice, relates to emotion regulation and to health (Hadash et al., 2016; Desbordes et al. 2015).

Like mindfulness, equanimity is complex and multifaceted, with multiple conceptualizations. For example, equanimity is defined by Carmody et al. (2009) as the moment-to-moment maintenance of equilibrium despite provocative experiences. By this
definition, a state of equanimity includes increased emotional stability, decreased emotional interference in attention, higher feelings of inner peace (or acceptance), and lower overall stress (Juneau et al., 2020). As defined by Desbordes et al. (2015), equanimity is a mental state or dispositional quality of impartiality and balance towards all experiences and objects, regardless of their pleasurable or aversive valence. Similarly, Hadash et al. (2016), inspired by Olendzki (2006), described equanimity as the decoupling of hedonic tone (pleasure or aversiveness) from desire for experiences, with desire alternately shaped by an individual’s purposeful intentions, values, and longer-term goals. Impartiality towards experiences arises from this detachment from pleasure or aversiveness typically associated with experiences. These conceptualizations of equanimity each contrast the tendency to regulate emotions by either rumination or suppression.

*Trait Mindfulness in the Cardiovascular Context: Equanimity*

Research literature discussing explanatory models of equanimity on health are in a relatively early state, though several competing models have been published. Desbordes et al. (2015) theorized equanimity involves hastened stress recovery, alongside the decoupling of events from affective valence (which includes emotional reactions). They posit the observing attitude towards all experiences (regardless of hedonic tone) manifested by equanimity does not actually modify acute emotional and physiological *reactions* to said experiences (Hadash, Segev, Tanay, Goldstein, & Bernstein, 2016). Instead, by modifying behavioral responses to stress towards faster disengagement from the stressor, higher equanimity may generate a faster *return to baseline* following a
stressor, shortening the time-course of the overall stress response, and minimizing allostatic load.

**Figure 3**

*Representation of Effects of a ‘Mindful’ Response, Contrasted with Rumination and Suppression, on Physiological Responding*

*Note.* Figure 3 represents three various approaches to emotion regulation of a stressor impact physiological stress responses, like BP. Response duration before return to baseline is pictured on the x-axis, while the magnitude of the response is pictured on the y-axis. An equanimous response is depicted using the solid line. Generic rumination and suppression curves are conveyed using the dotted lines. Modified from Moving Beyond Mindfulness – Defining Equanimity as an Outcome Measure in Meditation and
Contemplative Research, by Desbordes et al., 2015, retrieved from

Figure 4

*Effects of Equanimity on Physiological Responding to Stress Over Time*

*Note.* Figure 4 represents stressor impact on physiological stress responses, like BP, over
time and repetition, in the context of an equanimous stress response. Equanimous
responses are shown to decrease in magnitude over time.
In a competing conceptualization, Hadash et al. (2016) theorize equanimity modifies the degree to which pleasurable or aversive experiences generate seeking or avoiding said experiences. Instead, within the context of high equanimity, an individual’s values, intentions, and goals drive desire for experiences. They posit this is typified by lower autonomic reactivity to an experience’s hedonic tone resulting from normative learning processes occurring over time. Hadash et al. believe high equanimity may gradually increase Nonreactivity via decreased distress associated with having aversive experiences. Within Hadash et al.’s conceptualization of equanimity, consistent high equanimity over time would likely decrease the initial magnitude of stress responding to future stressors, protect against unhealthy forms of emotion regulation like rumination and suppression, and promote behavioral responses to stress in alignment with an individual’s beliefs and values.

Desbordes et al.’s (2015) and Hadash et al.’s (2016) understandings of how equanimity may relate to BP are not inherently contradictory. Equanimity may modulate the length of emotional and physiological stress responses acutely and decrease the initial response magnitude of stress responses over time. Given the causal links between stress, allostatic load, and cardiovascular system damage, it is possible acute changes in stress responses (Desbordes et al., 2015), combined with changes in longer-term behavior through naturalistic learning processes (Hadash et al., 2016), may impact normative BP, apart from shorter-term BP responses to stress.

For example, within the Theravada tradition, the mind and consciousness are understood as a series of distinct but interconnected momentary instances, each causally
and rapidly flowing into the next (Karunamuni & Weerasekera, 2019). As an innate characteristic of consciousness, the mind is understood to seek out pleasurable experiences while avoiding aversive ones. Both seeking, or over-identification (rumination) and avoiding, or under-identification (suppression) with experiences results in ‘disturbing emotions’, which distract from present moment awareness and necessitate appraisal. This process of appraisal generates attraction to pleasant stimuli and aversion towards unpleasant stimuli, driving positively and negatively valanced affective states. In turn, these emotional states lead to learned behavioral patterns, including stress appraisal and emotion regulation patterns.

Over time, disturbing emotions result in restricted focus of attention. This restriction impairs cognition, strengthening the tendency to mindlessly react to stimuli based on prior experiences, cyclically generating more over- or under-identification with experiences. This Buddhist understanding of normative experience mirrors modern psychological understandings of the pathway between chronic stressors, emotional and biological stress responding, allostatic load, and stress-related diseases like HTN. Within the Buddhist tradition, equanimity is antithetical to this pattern of experience.

Equanimity, as defined by both Desbordes et al. and Hadash et al., does not refer to suppressing the expression of inward emotions, but instead a unique form of emotion regulation including 1) emotional balance and calm despite emotional valence of experiences, and 2) decreased motivational and emotional responses towards pleasant experiences, arising from the decoupling of desire for experiences and hedonic tone (Juneau et al. 2020). Based on these definitions, people with higher equanimity would
likely intentionally approach all experiences with an unbiased awareness, regardless of
the inherent affective valence ordinarily associated with said experience, allowing for
responses to all experiences to be informed by values instead of acute affective valence
(Juneau et al., 2020). Ultimately, equanimity may generate beneficial longer-term change
in ineffective patterns of behavioral and physiological responses to stress, linked with
higher BP.

*Measuring Equanimity*

Measuring equanimity poses several challenges. Although several self-report
scales attempting to capture trait equanimity have been developed (Juneau et al., 2020;
Rogers et al., 2021) the different components measured in each are indicative of the still
debate low conceptual clarity regarding equanimity, and emblematic of the early stage of
equanimity-focused research (Desbordes et al., 2015). However, early evidence links
certain facets from Baer’s five-facet model with equanimity, as measured by the recently
published Equanimity Scale (EQUA-S). Reflecting Juneau et al.’s conceptualization of
equanimity which blends both Desbordes et al. (2015) and Hadash et al.’s (2016)
conceptualizations, the EQUA-S assesses even-minded state of mind (quality of being
calm and balanced, despite either pleasant or aversive emotions; Desbordes et al., 2015)
and hedonic interdependence (decoupling of desire for experiences from their hedonic
tone; Hadash et al., 2016). A recent factor analysis of the EQUA-S found both even-
minded state of mind and hedonic interdependence (decoupling) correlated with the trait
mindfulness facets of Nonjudging, Nonreactivity, and Acting with Awareness, measured
using Baer et al.’s Five-Facet Mindfulness Questionnaire (FFMQ), a measure of
mindfulness as represented by Baer’s five-facet model (2006). Even-minded state of mind most strongly correlated with Nonreactivity \((r = 0.540)\) and Nonjudging \((r = 0.296)\), while hedonic interdependence most strongly correlated with Acting with Awareness \((r = 0.210)\), Nonreactivity \((r = 0.164)\), and Nonjudging \((r = 0.136)\) (Juneau, 2020). Neither Even-minded state of mind nor hedonic interdependence significantly correlated with the Observing or Describing facets of the FFMQ (Juneau et al., 2020).

When considering items of the FFMQ through this lens of equanimity, reverse coded Nonjudging items (e.g., “I criticize myself for having irrational or inappropriate emotions.”; “When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about.”) may reflect and associate with both even-minded state of mind and hedonic interdependence. Nonreactivity items (e.g., “In difficult situations, I can pause without immediately reacting.”; “I perceive my feelings and emotions without having to react to them.”) may associate with even-minded state of mind most closely, though they also reflected hedonic interdependence (Baer et al., 2008; Juneau et al., 2020). Items from the Acting with Awareness facet (e.g., “I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted.”; “I find it difficult to stay focused on what’s happening in the present.”; “It seems I am “running on automatic” without much awareness of what I’m doing.”) provided the closest reflection of hedonic interdependence of the FFMQ facets, though they also associated with even-minded state of mind.
MAT and Equanimity: Similarities and Differences

MAT and equanimity share key features. Critically, both MAT and equanimity hypothetically impact stress responses and emotion regulation strategies, thereby potentially modifying allostatic load, BP, and CVD risk. Moreover, they also have similarities on the foundational level of their key constructs. Both MAT and equanimity center upon constructs akin to present-moment awareness and acceptance. Within MAT, attention monitoring is analogous to present-moment awareness. For equanimity, both an even-minded state of mind regardless of pleasurable or aversive emotions, and decreased reactivity to pleasurable events arising from decoupling desire for experiences from hedonic tone, require skill in accurate present-moment awareness.

Similarly, both MAT and equanimity involve acceptance, or acceptance-related constructs. MAT directly names acceptance as a core construct in its model. Within the context of MAT, Lindsay and Creswell intend acceptance to encapsulate several acceptance-related constructs, specifically including equanimity among said constructs (Lindsay and Creswell, 2017). They define acceptance as all events being received with openness regardless of hedonic tone, mirroring the decoupling concept included within Hadash et al.’s definition of equanimity. However, acceptance within MAT does as closely mirror the even-minded state of mind central to equanimity, as it is defined by Juneau et al. (2020).

Though MAT and equanimity (and the pathways by which they may relate to BP) are markedly similar, they are not identical. Namely, they differ in their mathematical calculation. The basic theory of MAT describes beneficial effects of mindfulness as
arising from the *interaction* between two facets of mindfulness—attention monitoring (corresponding to the FFMQ Observing subscale) and acceptance (corresponding to the FFMQ Nonjudging and Nonreactivity subscales). In comparison, initial evidence indicates equanimity most strongly correlates with the FFMQ subscales of Nonjudging, Nonreactivity, and Acting with Awareness, instead of observing (Juneau et al., 2020). Moreover, whereas MAT involves mathematical interaction, equanimity is stated to *underlie* mindfulness and would likely be best assessed using a latent variable from the shared variance of Nonjudging, Nonreactivity, and Acting with Awareness.

**Results of Studies on Trait Mindfulness in the Cardiovascular Context**

Relatively few studies have examined the links between trait mindfulness and BP, and fewer still within the context of MAT or equanimity. Initial research testing the premise of MAT within the context of BP partially demonstrates expected relationships between the interaction of awareness, acceptance, and BP. In a study intended to directly test the MAT hypothesis, Ede, Walter & Hughes (2020) investigated if higher trait mindfulness (measured by the FFMQ) in a non-clinical adult sample predicted lower BP, heart rate (HR), and better HR variability (HRV) during an emotional stressor. Although individual facets of trait mindfulness did not significantly relate to cardiovascular stress responses, exploratory analyses indicated higher Acting with Awareness coupled with high Nonjudging predicted lower DBP reactivity, specifically.

Though both SBP and DBP are associated with cardiovascular health and disease risk, SBP is the stronger predictor of cardiovascular events and risk in adults (Mourad, 2008). Given this context, it is unclear why the interaction of high Acting with
Awareness and high Nonjudging would predict lower DBP, but not SBP. One earlier study by Tomfohr, Pung, Mills and Edwards (2015) also investigated the interactive relationships between subscales of trait mindfulness, measured by the FFMQ, and BP. Tomfohr et al. found higher Acting with Awareness coupled with higher Nonjudging associated with both lower clinic SBP and DBP, whereas all other combinations of trait mindfulness facets were null.

These initial results are mixed and unclear. Regardless, the published research investigating these postulated links between trait mindfulness facets, viewed through either the lens of MAT or equanimity, is limited. It is likely further studies are necessary to begin drawing any firm conclusions regarding these links.

**Difficulties Measuring Trait Mindfulness**

Substantial variation in measurement methodology of trait mindfulness likely contributes to this inconsistency within research findings. Broadly speaking, measuring trait mindfulness has inherent difficulty, given the lack of a universally accepted definition of mindfulness or agreement regarding the concepts to which it refers (Van Dam, 2018). For example, while most definitions of trait mindfulness involve an individual’s innate ability to pay nonjudgmental attention to the present moment experience, both unidimensional and multidimensional models of trait mindfulness exist, as well as unidimensional and multidimensional scales meant to measure these models. Initial attempts to operationalize and assess trait mindfulness centered on mindfulness as a unidimensional construct (Heeren et al., 2021). Several prominent unidimensional measures of trait mindfulness include the Trait Mindful Attention Awareness Scale.
(Trait-MAAS), the Freiburg Mindfulness Inventory (FMI), and the Langer Mindfulness Scale (LMS). Although each of these measures result in unidimensional trait mindfulness scores, they differ in the heterogenous qualities of trait mindfulness they reflect.

For example, while the Trait-MAAS includes items measuring both attention to and awareness of the present moment, these disparate items are summed during scoring for a single total score (Brown & Ryan, 2003). The FMI aims to assess “all aspects of mindfulness”, with items reflecting traits of attention, awareness, and nonjudgment towards the present moment experience, but again is summed for a single total score (Walach et al., 2001). In contrast with many Buddhist-inspired measures of trait mindfulness, the LMS was developed to assess qualities of mindfulness as it is conceptualized within Western psychology. Items included in the LMS measure factors such as openness to novel experiences, cognitive flexibility, and engagement, which are then summed into an overall mindfulness score (Pirson & Langer, 2015).

Summing subscales within a single measure into a total score is debated as a potentially problematic practice. As seen in measures of trait mindfulness, with subscales spanning constructs of attention and awareness, ability to describe experiences, acceptance or lack of judgment towards experiences, lack of reactivity towards experiences, self-compassion, and more, subscales within a single measure often independently represent varied constructs (Baer et al., 2006; Baer et al., 2008). Summing orthogonal constructs to constitute a single unitary construct requires strict statistical constraints, clear definitions of the target construct, and tests of how the target construct
relates to other theoretically related constructs (Smith et al., 2009; Siegling & Petrides, 2014; McNeish & Wolf, 2020).

Use of orthogonal constructs within a single measure with a total score may require the existence a unitary latent variable underlying all items within the scale (McNeish & Wolf, 2020). Mindfulness, though measured both unidimensionally and multidimensionally, is generally not philosophically or theoretically considered a singular, unidimensional construct. Currently, mindfulness is postulated to involve multiple factors working in tandem (Van Dam et al., 2018). These factors may disparately be impacted by mindfulness training and may have distinct effects on behavior and health. Measures of trait mindfulness attempting to encapsulate multiple facets of mindfulness which are subsequently summed into a single total score inherently prevent the differentiation of said facets of mindfulness. Therefore, the use of such summed trait mindfulness scales has thus been called indefensible within the context of mindfulness research (Siegling & Petrides, 2014).

It is generally considered more useful to utilize multidimensional models of trait mindfulness, when seeking to explore the links between trait mindfulness and cardiovascular health (Heeren et al., 2021). Several prominent multidimensional models of trait mindfulness include Shapiro, Carlson, Astin & Freedman’s three-component model, focusing on the cyclic interactions of intention, attention, and attitude (2006); Grabovac et al.’s model, centering on attention, acceptance, ethical practice, and attachment/aversion to feelings (2011); and Baer et al.’s five-facet model (2006). Many subscales included amongst the various multidimensional measurements of trait
mindfulness reflecting these models thematically fit within shared factors by which mindfulness is typically conceptualized. However, convergent validity of these scales falls within only the moderate range (Baer et al., 2006).

Baer’s five-facet model, by encapsulating myriad facets of trait mindfulness included across multiple prior prominent models, was in part designed to resolve this dilemma. The FFMQ was derived from a factor analysis of items included in multiple earlier trait mindfulness measures. These include the Trait-MAAS (Brown & Ryan, 2003), the Kentucky Inventory of Mindfulness Skills (Baer et al., 2004); the FMI (Buchheld et al., 2001); the Cognitive and Affective Mindfulness Scale (Feldman et al., 2007); and the Mindfulness Questionnaire (Chadwick et al. 2005). Four of these facets—Observing, Describing, Nonjudging, and Acting with Awareness—were largely derived from Baer’s earlier measure, the KIMS, whereas Nonreactivity included items from the FMI and Mindfulness Questionnaire (2006).

Still, differences in response properties and factor structures between non-meditators and meditators raise psychometric concerns for the FFMQ (Christopher, Charoensuk, Gilbert, Neary, & Pearce, 2009). Several studies indicate non-meditators seem to overreport dispositional mindfulness. This is particularly well established within the FFMQ’s Observing facet. Although items included within the FFMQ’s Observing facet are reflective of awareness of the present moment experience, prior studies have found Observing does not correlate with other FFMQ subscales in non-mediator samples (Baer et al., 2008; Siegling & Petrides, 2014; Lilja et al., 2013). Baer et al. (2016) posit Observing facet items may be interpreted differently by meditators and non-meditators.
While in meditators, Observing items may reflect open and curious interception, non-meditators may score Observing items highly due to being particularly judgmentally reactive to the present moment (Baer et al., 2016).

Research indicates biased responding is present in multiple items of the FFMQ, across all facets, not just Observing. Specifically, non-meditators tend to score reverse coded items with higher scores, and positively-worded items with lower scores (Van dam et al., 2009). In an analysis of differential item functioning (DIF) within the FFMQ, 18 items total showed significant indication of positive or negative wording-based biased responding. These included five items in Observing, with the bias against meditators, two items in Describing, which were biased against both meditators and non-meditators, six items in Nonjudging, with the bias against non-meditators, two items in Nonreactivity, with the bias against meditators, and three items in Acting with Awareness, which were biased against non-meditators. These results are especially problematic for assessing trait mindfulness in non-meditators in the Nonjudging facet, and for meditators with the Observing facet, as a majority of the items show evidence of DIF.

The original factor analysis completed by Baer et al. (2006) spurring the development of the five-factor model and the FFMQ suggested five distinct lower-order factors present across multiple measures of mindfulness, which load into a single, higher order ‘mindfulness’ factor. These results imply a unitary root factor, driving each of the five facets, is present (Heeren et al., 2021). This aligns with equanimity, which in Theravada Buddhist theory is believed to ‘underlie’ and cause mindfulness. Myriad factor analyses (Neuser, 2010; Williams & Karl, 2014; Gu et al., 2016; Karl & Fischer, 2020)
have similarly found either a four-factor structure or replicated Baer et al.’s five-factor structure. Four factors appear supported in non-meditating samples, with Observing typically not associating with Nonjudging (Baer et al., 2006; Baer et al., 2008, Lilja et al. 2011; Michalak et al. 2016; Curtiss & Klemanski, 2014), and five factors supported within experienced mediators, or post MBI (Baer et al., 2006; Baer et al., 2008).

However, one recent factor analytic study of the FFMQ investigated the psychometric structure of each FFMQ facet independently, first within a sample of 522 adults, then replicated in a separate clinical sample of 454 adults (Pelham III et al., 2019). Results suggested each of the five factors are themselves multidimensional, not individual, unidimensional factors, and identified method factors for the Describing (reverse-scored items) and Acting with Awareness (items including the word “distraction”). The authors posited the inclusion of duplicative items (e.g., FFMQ item 5 “When I do things, my mind wanders off and I’m easily distracted”, and item 13 “I am easily distracted”) due to their own correlation may have generated overestimated factor loadings. The authors suggested these items were thus potentially incorrectly included in the measure. The authors suggest the use of latent variable models as a possible solution to the multidimensionality of the FFMQ facets.

These issues highlight the importance of using multifaceted scales when assessing mindfulness, and critically examining the rationale behind measurement choice. Moreover, they emphasize the need for defensible, theory-driven choices regarding how individual items and subscales within a measure are statistically analyzed. Studies
utilizing self-report measurements of trait mindfulness, including the FFMQ, must have clarity on what specific concepts they intend to capture, and why.

The Proposed Study

In summary, HTN is prevalent, dangerous, and for many, uncontrolled even with prescription of anti-hypertensive medications. Chronic stress, combined with unhealthy emotion regulation strategies, generates allostatic load, and leads to consistent states of allostatic overload. This process is a key cause of HTN and other cardiovascular diseases. MBIs are increasingly used to address high stress and stress-related diseases including HTN and CVD, but results are inconsistent. These conflicting results are likely partially attributable to the hypothetical active components of MBIs within a cardiovascular context remaining relatively unestablished in the research literature, and the critical gap in understanding of whether trait mindfulness can impact cardiovascular health, and how (Loucks et al., 2015).

This discrepancy of early conceptual understanding versus a comparatively advanced stage of research (Heeren et al., 2021) highlights the need for earlier stage research firmly establishing the correlational links between trait mindfulness and objective measures of cardiovascular health. Yet, there is marked variation in the conceptualization and measurement of trait mindfulness, and subsequent variation in how trait mindfulness is postulated to impact health (Desbordes et al., 2015). This variation, paired with psychometric concerns about the most widely used measure of trait mindfulness (FFMQ), may contribute to the mixed findings present across the limited extant studies examining trait mindfulness in a cardiovascular context, and likely
contributes to the mixed findings in studies on the effects of MBIs on cardiovascular health (Ede et al., 2020, Van Dam et al., 2018).

Therefore, to deepen our understanding of the basic links between mindfulness and BP, this study used two theoretically guided variations of the FFMQ to test two conceptualizations of how trait mindfulness relates to BP. The first of these two conceptualizations, MAT, postulates that an interaction between two qualities (awareness and acceptance, with equanimity subsumed within acceptance) modifies stress responses and emotion regulation, and thereby may affect BP. Second, Theravada Buddhist tradition indicates equanimity, a factor involving moment-to-moment emotional balance and calm and the decoupling of desire for experiences and hedonic tone, and posited to underlie mindfulness itself, may similarly modify BP.

The objectives of the current study were to: (1) extend our understanding of how mindfulness, conceptualized both as the interaction of mindful awareness and acceptance posed in MAT, and as equanimity from a Buddhist framework, relate to BP; and (2) to better understand if or to what degree stress and emotion regulation strategies moderate and mediate these relationships, respectively. We aimed to answer the following research questions: (1) Does higher equanimity predict lower BP, and does the strength of this relationship vary across levels of stress, such that the relationship between equanimity and BP is stronger at higher levels of stress? (2) To what degree is this relationship explained by rumination and suppression? (3) To what degree does the interaction of mindful awareness and acceptance described in MAT predict BP?
Chapter 2

Methods

Dataset

The current study analyzed baseline data from the Serenity Study (NCT02371317), a multi-site RCT comparing the efficacy of MBSR training and stress-management education (SME) in lowering BP among adults with pre-HTN.

Participants

Participants (N = 296; M<sub>age</sub> = 50, women = 57.9 %, SD = 12.77) included medicated and unmedicated adults with and without pre-HTN. Pre-HTN was classified as SBP of 120-139 or DBP of 80-89, consistent across two clinic assessments, consistent with criteria established by the Seventh Report of the Joint National Committee (JNC) on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. 206 (69.1%) identified as White, 74 (24.8%) as Black, 19 (6.4%) as Asian, 6 as Native American/Alaskan (2%), and 1 as Pacific Islander (.3%). Exclusion criteria from the RCT included taking anti-hypertensive medications, morbid obesity (BMI = 40); having an existing heart disease as evidenced by a pacemaker, atrial fibrillation, myocardial infarction, percutaneous transluminal coronary angioplasty, coronary artery bypass graft within six months of enrollment, persistent tachyarrhythmia, congestive heart failure, uncorrected primary valvular disease, hypertrophic or restrictive cardiomyopathy, or uncorrected thyroid disease; having chronic kidney disease; or falling within JNC risk category C (including target organ damage and diabetes). Additional exclusion criteria
included if possible participants were pregnant or planning to become pregnant within nine months, lactating, unable to comply with assessment procedures, unable to provide informed consent, had dementia, abused alcohol or drugs in previous 12 months, regularly consumed more than 21 alcoholic drinks per week, were a current smoker, or had at least 27 hours of formal (or 56 hours of informal) meditation or yoga training.

Open-label (OL; N = 136; M_age = 51.6) participants were participants who were excluded from the formal RCT due to not meeting eligibility criteria. However, they were included in the OL group if they still opted to take part in the MBSR training or SME interventions in exchange for providing BP and other relevant data. OL participants were included in the trial to form viable MBSR training and SME group sizes. Many of the OL participants still had relatively high BP and qualified as having pre-HTN, given the recently lowered criteria in American Heart Association high BP guidelines (Whelton et al., 2017). Moreover, the inclusion of OL participants increases the sample size and improves the statistical power of the current analyses. See Table 1 for further participant demographic information.
Table 1

Sample Demographics

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<td>160</td>
<td>136</td>
</tr>
<tr>
<td>Race (% Black)</td>
<td>24.40%</td>
<td>27.0%</td>
<td>21.3%</td>
</tr>
<tr>
<td>Race (% White)</td>
<td>69.2%</td>
<td>70.4%</td>
<td>67.6%</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>50.8</td>
<td>50.11</td>
<td>51.62</td>
</tr>
<tr>
<td>Gender (% Female)</td>
<td>58.3%</td>
<td>53.2%</td>
<td>64.4%</td>
</tr>
<tr>
<td>SES (% Lower)</td>
<td>45.7%</td>
<td>49.7%</td>
<td>41.1%</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>28.73</td>
<td>29.35</td>
<td>27.99</td>
</tr>
<tr>
<td>Family History of HTN (% Yes)</td>
<td>74.0%</td>
<td>70.5%</td>
<td>78.0%</td>
</tr>
<tr>
<td>Perceived Stress Scale Score</td>
<td>17.81</td>
<td>17.59</td>
<td>18.07</td>
</tr>
<tr>
<td>Clinic SBP (mmHg)</td>
<td>123.98</td>
<td>125.10</td>
<td>122.68</td>
</tr>
<tr>
<td>Clinic DP (mmHg)</td>
<td>73.02</td>
<td>73.64</td>
<td>72.29</td>
</tr>
<tr>
<td>Observing</td>
<td>26.65</td>
<td>26.84</td>
<td>26.43</td>
</tr>
<tr>
<td>Describing</td>
<td>27.92</td>
<td>28.76</td>
<td>27.85</td>
</tr>
<tr>
<td>Modified Acting with Awareness</td>
<td>20.54</td>
<td>20.76</td>
<td>20.29</td>
</tr>
<tr>
<td>Nonjudging</td>
<td>28.00</td>
<td>28.02</td>
<td>27.98</td>
</tr>
<tr>
<td>Nonreactivity</td>
<td>22.06</td>
<td>21.09</td>
<td>21.02</td>
</tr>
<tr>
<td>Acceptance</td>
<td>49.09</td>
<td>49.14</td>
<td>48.88</td>
</tr>
</tbody>
</table>

Note. OL = Open Label group. Not eligible for the Serenity Study randomized clinical trial (RCT) but were included as non-RCT participants in exchange for providing baseline and outcome data. *Acting with Awareness scale was modified. See text for details.

Procedure

The institutional review boards of Kent State University and the University of Pennsylvania reviewed and approved study procedures. All potential participants completed initial eligibility and medical screening over the phone by study staff, or
online via REDCap. Potential participants not excluded after the initial screening were then scheduled for the first in-clinic screening session, where clinic BP was determined, following standard American Heart Association (AHA) procedures (Pickering et al., 2005). Potential participants were asked to refrain from vigorous exercise and consuming alcohol and caffeine for at least four hours before their appointment time. Potential participants with three consistent (within 5 mmHg) pre-hypertensive (SBP 120-139 mmHg, DBP 80-89 mmHg) BP readings during the initial BP screening visit were further considered as eligible. One week later, a second, confirmatory clinic screening of BP determined final eligibility by repeating the BP assessment. Participants were then consented and enrolled, and baseline assessments of demographic information and self-report measures completed.

**Measures**

**Clinic Blood Pressure**

Clinic BP measures taken during the first study visit, pre-intervention, were utilized in the current analyses. Clinic BP was measured via an automatic oscillometric monitor, the Datascope Accutorr Plus™ (Mawah, NJ, USA). All clinic BP assessments were completed in a quiet and climate-controlled room, following AHA guidelines (Pickering, 2005). Participants had their readings taken from their non-dominant arm (supported at heart level) while seated in a chair with feet flat on the floor. The mean of three consistent seated readings of BP on the non-dominant arm was calculated to find clinic BP. If these three readings varied by more than 5 mmHg for SBP or DBP, further readings were taken at five-minute intervals, until either three consecutive readings
ranging within 5 mmHg were collected, or until a maximum of six measures were taken. Potential participants whose SBP or DBP varied by more than 5 mmHg after six readings were considered ineligible due to excessive variability in BP.

**Five Facet Mindfulness Questionnaire**

Trait mindfulness was assessed via the Five Facet Mindfulness Questionnaire (FFMQ; see Appendix A), a 39-item gauge of trait mindfulness with questions distributed amongst five core facets including: Observing (8 items; α = .810), Describing (8 items; α = .874), Non-Judgment (8 items; α = .934), Nonreactivity (7 items; α = .881), and Acting with Awareness (8 items; α = .902) (as taken from the current study sample).

**Equanimity**

Prior factor analytic evidence links equanimity with three facets of the FFMQ: Nonjudging, Nonreactivity, and Acting with Awareness (Juneau, 2020). This initial evidence supports equanimity as underlying these FFMQ facets and possibly responsible for any shared variance between them. To yield a measure of equanimity given these findings, the current study utilized structural equation modeling (SEM). A latent equanimity variable was estimated from the shared variance between the Nonreactivity and Nonjudging facets, and a modified Acting with Awareness facet of the FFMQ, in which two items were excluded based on DIF*.

Table 2 outlines the FFMQ facets and/or specific items included and excluded within the latent Equanimity variable. Guided by findings from an adult sample then replicated within a clinical sample, two of three items that included the term ‘distracted’
were excluded from the Acting with Awareness facet score in the present analyses (Pelham III et al., 2019). Pelham III et al. identified overinclusion of items with the term ‘distracted’ generated overestimated factor loadings within Baer et al.’s (2006) initial factor analysis and were likely incorrectly included in the FFMQ. Items excluded for this reason include item five (“When I do things, my mind wanders off and I’m easily distracted.”) and item 13 (“I am easily distracted.”). Of the three Acting with Awareness items including the term ‘distracted’, item 5 and item 13 have shown DIF (Van dam et al., 2009). Item 8 (“I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted”) was retained as it does not display DIF in non-meditators.

Table 2

**FFMQ Facet Inclusion/Exclusion in the Latent Equanimity Variable**

<table>
<thead>
<tr>
<th>Facet</th>
<th>Rationale for inclusion/exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonjudging</td>
<td>Reflects both even-minded state of mind and hedonic interdependence</td>
</tr>
<tr>
<td>Nonreactivity</td>
<td>Reflects both even-minded state of mind and hedonic interdependence</td>
</tr>
<tr>
<td>Acting with Awareness</td>
<td>Reflects hedonic interdependence</td>
</tr>
<tr>
<td>Observing</td>
<td>Not reflected in equanimity; biased in non-meditating samples</td>
</tr>
<tr>
<td>Describing</td>
<td>Not reflected in equanimity</td>
</tr>
<tr>
<td>Acting with Awareness Item five</td>
<td>Included term ‘distracted’, displays DIF</td>
</tr>
<tr>
<td>Acting with Awareness Item thirteen</td>
<td>Included term ‘distracted’, displays DIF</td>
</tr>
</tbody>
</table>

*Note.* Facets included appear on a white background, while excluded facets and/or items appear on a gray background.
Although results of Van dam et al.’s prior study indicated DIF in non-meditator samples amongst multiple items from the Nonjudging and Acting with Awareness subscales, apart from items 5 and 13, which were both indicated by Van Dam et al.’s findings to show DIF and include the term ‘distracted’, these items remain included in the current study (Van Dam et al., 2009). First, the prior study sample of non-meditators was comprised of undergraduate students, whereas the current study sample is a clinical, mostly prehypertensive sample of adults (\( \bar{x} \text{ age} = 50.7 \)).

Second, were all these items to be excluded, six Nonjudging and three Acting with Awareness items would be removed from the present analysis. This is particularly concerning as Acting with Awareness chiefly reflects equanimity’s hedonic interdependence, and Nonjudging reflects both even-minded state of mind and hedonic interdependence. Removal of these items could lead to an underrepresentation of hedonic interdependence, a core element of equanimity, in the calculation of the latent equanimity variable (Hadash et al., 2016). Therefore, apart from items 5 and 13 of the FFMQ, other items identified by Van Dam et al. (2009) within the Nonjudging and Acting with Awareness facets as showing DIF within a non-meditating student sample were retained in the present analysis.

As a final note, as latent variables inherently cannot be directly observed, the mean, standard deviation, and other descriptive of the equanimity latent variable are not listed in the current study. However, the mean of the equanimity latent variable is zero, as in MPLUS 8.4, any latent variables generated have means imposed at zero (Muthen, 2010).
**Trait Mindfulness—Monitor and Accept Theory**

To yield a composite measure of trait mindful awareness and acceptance as outlined in Lindsay & Creswell’s (2017) original MAT paper, the current study tested the interactive effects of three trait mindfulness facets from the FFMQ. These facets included Observing (awareness), and the sum of Nonjudging and Nonreactivity (acceptance). Although Observing historically shows biased responding depending on level of meditation experience (Baer et al., 2006), Observing was specifically included as MAT specifically states the Observing subscale of the FFMQ represents attention monitoring (Lindsay & Creswell, 2017).

**Perceived Stress**

Perceived stress was measured via the Perceived Stress Scale (PSS; see Appendix B), a 10-item scale assessing perceived stress level over the past 30 days, (e.g. reverse scored “In the last month, how often have you felt you were on top of things?”). Items are rated using a Likert scale. After reversing the scores for four items, summed total scores range from 0-40, with higher scores indicating greater perceived stress ($\alpha = .894$).

**Rumination and Suppression**

Rumination was measured via the rumination scale of the Response Styles Questionnaire (RSQ; see Appendix C), a 22-item scale assessing the tendency to ruminate as an emotion regulation strategy, (e.g., I think, “Why can’t I handle things better?”; “I think "What am I doing to deserve this?"). The RRS has good internal reliability (Luminet, 2004). Suppression was measured via the Emotion Regulation
Questionnaire (ERQ; see Appendix D), a 10-item scale assessing the habitual use of expressive suppression (e.g., “When I am feeling negative emotions, I make sure not to express them”) and cognitive reappraisal (e.g., “When I’m faced with a stressful situation, I make myself think about it in a way that helps me stay calm”) as emotion regulation strategies. The ERQ expressive suppression subscale contains 4-items, has adequate internal consistency reliability (α = .76-.80) in general community samples (Preece, Becerra, Robinson & Gross, 2019).

**Data Analysis Plan**

The current data analysis plan is written to follow the Eight Steps of Data Analysis (Fife, 2019) to avoid engagement in problematic statistical practices, and minimize bias in analysis and interpreting results.

First, to minimize statistical fishing for significance, research questions and statistical decision criteria are stated outright below. Descriptive statistics were performed using SPSS 29 software to assess psychometric properties of the variables, including internal consistency of study measures. All continuous predictors were centered to avoid issues of multicollinearity. Prior to the main analyses, the residuals of variables of interest were graphically screened for violations of relevant statistical assumptions, including linearity, normality, homoscedasticity and outliers (Civelek, 2018) using QQ and residual scatterplots. Based on data collection methods outlined above, the data do not violate the assumption of independence.
The formal analyses were performed using MPLUS 8.4 software. Graphics were plotted matching the theoretical hypotheses further identifying possible violations of statistical assumptions and improving understanding of the results. Finally, in interpreting the results, emphasis was placed on both parameter effect sizes and statistical significance, to better focus interpretation on clinical relevance of results. The FDA identifies a “clinically meaningful” change in BP to be 3 mmHg. Therefore, results will be considered clinically relevant if half a standard deviation change in the equanimity or the interaction between awareness and acceptance predicted a 3 mmHg or greater change in SBP or DBP (Mouelhi et al., 2020; Nguyen, 2007).

**Research Question 1**

Does higher equanimity predict lower BP, and does the strength of the purported relationship vary across levels of stress? Prior evidence examining MBIs suggests for beneficial effects of mindfulness to occur, it is likely heightened stress must be present for mindfulness to impact (Greeson & Chin, 2019). Therefore, it was hypothesized this relationship is reflected at the trait level, and at higher levels of stress, the relationship between equanimity and BP is stronger. These hypothesized moderation effects were tested with a confirmatory data approach using structural equation modeling (SEM; Figure 5). A latent equanimity variable derived from the covariation of three trait mindfulness facets (Acting with Awareness, Nonjudging, Nonreactivity) was used to predict BP. Perceived stress was included as a moderator of this relationship.
To improve specificity of the outcome variable, reduce error and reduce confounding bias, possible confounding variables of the relationships between equanimity and BP were included in this model (Jager et al., 2008). Confounders of both equanimity and BP are age and SES (measured by household income). Each confounder was selected because they could potentially cause both equanimity (as calculated in the

Note. See Appendix E for MPLUS code testing this research question.
Covariates of BP included in this model are gender, BMI, and family history of hypertension. Age, SES, and BMI were each coded as continuous variables, whereas gender and family history of hypertension were dummy coded. For gender, 0 = male, 1 = female, and for family history of hypertension, 0 = no, 1 = yes. Although SES was collected as an ordinal scale variable, as it had 9 separate categories ranging from $0-$5,000 to $100,000 or greater, it was treated as a categorical variable instead of dummy coded, to avoid loss of explanatory information (Rhemtulla et al., 2012).

Models with Comparative Fit Index (CFI) greater than .90 and Root Mean Square Error of Approximation (RMSEA) less than .08 were interpreted to show appropriate fit to the observed data (Cangur & Ercan, 2015). CFI and RMSEA are not available in MPLUS 8.4 with latent variable interaction models wherein means, variances, and covariances are insufficient fit statistics for model estimation. Therefore, using Maslowlky et al.’s two step method, these fit statistics were instead calculated on two similar models: an alternate model without the latent variable interaction term, that instead treated stress as a confounding variable, and on an ‘empty’ nested model not including stress as a variable at all (2015). The empty model was calculated to provide an additional comparison for the alternate model if the alternate model showed improved fit versus the full theorized model.

Log-likelihood ratio tests, Akaike information criterion (AIC), and Bayesian information criterion (BIC) were utilized in calculating the relative fit of three comparative models: (a) the full model with an interaction term, (b) an alternate nested
model without the interaction term but with stress included as a confounding variable, and (c) the empty model without an interaction term or stress as a confounding variable. If the alternate model fit well but represented a significant decrement in fit compared with the full model via a log-likelihood ratio test, then it was concluded the full model with the interaction term fit similarly well (Maslowsky et al., 2015). Predictive relationships were interpreted via unstandardized regression coefficients (B) and p-values. B was chosen over standardized regression coefficients for reporting of the predictive relationships as BP is a metric with inherent clinical utility and meaning. Confidence intervals were reported. Moderation outcomes were visualized to help interpret interaction effects.

**Research Question 2**

To what degree is the purported relationship between equanimity and BP (n=296) explained by rumination and suppression? These hypothesized mediation effects were tested with a rough confirmatory data approach using SEM, shown in Figure 6. Rumination and suppression as mediators were tested in two separate models to reduce model complexity and ease interpretation. Like research question 1, confounders of equanimity and BP included in this model were age and SES. Covariates of BP included are gender, BMI, and family history of hypertension.
In this mediation analysis, the independent variable was latent equanimity, the dependent variable was SBP or DBP, and the mediator variable was either rumination or suppression. In the style of Baron and Kenny’s (1986) mediation analysis, complete mediation was recognized by 1) equanimity significantly predicting BP, 2) equanimity significantly predicting rumination or suppression, 3) rumination or suppression...
significantly predicting BP, and 4) the total effect of the equanimity-BP relationship being rendered non-significant when the mediator enters the relationship. The indirect effect of the mediation must have been significant, with confidence intervals not containing zero, for mediation to occur. Additionally, if the direct effect was not reduced to non-significant, this was instead considered partial mediation.

Model fit was similarly assessed to research question 1. Predictive relationships were again interpreted via B and p-values. Indirect and total effects were reported, though direct effects were not calculated. According to Kenny (2021), when latent variables are included in mediation models, the general assumption of the mediation total effect = direct effect + indirect effect is only approximately true. Due to this, it is inadvisable to compute either the total effect from the sum of the direct effect and the indirect effect, or the direct effect from the difference between the indirect effect and the total effect. As when latent variables are used in model, MPLUS 8.4 calculates both the indirect and total effects, but not the direct effect, the direct effects were not calculated or reported for this research question.

If mediation or partial mediation occurred, as indicated by the indirect effect of the mediation reaching significance, the proportion mediated was reported. Confidence intervals were again reported.

**Research Question 3**

To what degree do the interactive effects of mindful awareness and acceptance described in MAT predict BP? These hypothesized relationships were modeled with a
rough confirmatory data approach in SPSS 29 using a two-way moderated multiple regression, as shown in Figure 7. All non-categorical independent variables were centered. Age, gender, SES, BMI, and family history of hypertension were controlled for. R-squared, B, and associated p-values were the primary metrics used to determine if the interaction of mindful awareness and acceptance significantly predict BP. Outcomes were visualized to help interpret interaction effects.

Figure 7
Path Model for Research Question 3

Note. See Appendix G for SPSS code testing this research question.
Chapter 3

Results

Preliminary Analyses

Statistical Assumptions

As outlined within the methods section, Q-Q plots were utilized as a graphical technique to assess for normality of the variables of interest. The RRS appeared somewhat left skewed (Skewness value = .816, SE = .150). To address this, a log transformation was applied to the RRS variable (Skewness value = .272, SE = .150). All other variables of interest appeared adequately normal and were not corrected. Residual scatterplots were utilized to assess linearity and homoskedasticity of the data. The residual scatterplots of the variables of interest indicated the data were linear and had acceptable levels of homoskedasticity. VIF values for variables of interest were utilized to test for multicollinearity. All VIF values remained below ten (largest VIF = 2.462) indicating acceptable levels of multicollinearity (Forthofer et al., 2006). Outliers were tested using Mahalanobis distance. Four participants were identified via Mahalanobis distance as multivariate outliers and removed from the full sample.

To determine if the equanimity latent variable accounted for the covariation between each of the trait mindfulness facets included in the equanimity latent variable, models estimating the correlations between the FFMQ facets before and after accounting for equanimity were completed in MPLUS 8.4. Before accounting for the equanimity latent variable, the correlations between Acting with Awareness and Nonjudging ($r =$
0.492) were significantly greater ($Z = 5.257, p < 0.001$) than after accounting for the equanimity latent variable ($r = 0.104$). Similar findings were found in the correlations between Acting with Awareness and Nonreacting ($r = 0.407; r^l = 0.075; Z = 4.319, p < 0.001$), and Nonjudging and Nonreactivity ($r = 0.427; r^l = 0.022; Z = 5.256, p < 0.001$). These results indicate latent equanimity assumably contributes to the observed correlations amongst these facets.

**Missing Data**

Within the dataset, 6.9 percent of values across all variables were missing. Although missingness was not present within the main outcome variables (SBP or DBP), it was present among other variables of interest, including the FFMQ facets utilized for calculating the latent equanimity variable, and all confounding variables. Therefore, multiple imputation via the Markov chain Monte Carlo (MCMC) method was utilized.

MCMC is a Bayesian missing data approach which imputes missing values from a Markov chain, or a series of random states of the variables of interest, in which the distributions of the variables depend on previous values within the chain. The MCMC imputation starts by calculating reasonable initial values for means, variances, and covariances of variables. These initial values are obtained using listwise deletion. The sample is then divided into subsamples, with subsamples each presenting the same pattern of missingness. For each of these subsamples, the earlier calculated starting values are utilized to generate linear regressions using observed variables as predictors. These regressions are used to impute the missing data, which are random drawn from the simulated error distribution to create a complete imputed data set.
data set, the means, variances and covariances are recalculated, and the process is repeated using these updated values across multiple iterations. MCMC typically produces consistent and normal estimates, is advantageous for medium-sized samples, and can be performed within MPLUS 8.4 (Allison, 2012) and SPSS 29.

Three demographic variables were identified which significantly associated with missingness, including ZIP code ($r = 0.124, p = 0.049$), data collection site ($r = 0.257, p < 0.001$), and living arrangements ($r = -0.138, p = 0.026$). These demographic variables were included in the analysis as auxiliary missing variables within MPLUS 8.4, to better inform the multiple imputation (Enders, 2022). Within both MPLUS 8.4 and SPSS 29, 50 datasets were imputed and utilized for the current analyses, which was sufficient for convergence.

**CFA Analysis**

After statistical assumptions were checked, a confirmatory factor analysis (CFA) was completed. CFA is a method of structural equation modeling which uses the shared variance of observed variables to evaluate the accuracy by which these systems of variables measure a latent factor (Brown & Moore, 2012). CFA is often utilized to help capture theoretical constructs which are difficult to directly observe or measure. Therefore, CFA was used to confirm the proposed relationship between the observed FFMQ items selected for the equanimity latent variable, and the underlying latent construct of equanimity itself exists. The CFA was tested using MPLUS 8.4, using the maximum likelihood method.
As the CFA is testing one latent factor and includes three theoretically guided parameters (the Nonjudging, Nonreactivity, and a modified Acting with Awareness subscale), it was saturated. As saturated models have zero degrees of freedom, typical considerations of model fit indices are not meaningful in evaluating saturated model fit, though factor loadings can still be evaluated (Muthen, 2016). Factor loadings are the primary outcome of a CFA. Factor loadings are values which reflect how well an observed variable correlates with the latent factor. Higher factor loadings indicate stronger correlations with the latent factor. Although the general cutoff of factor loadings for inclusion of more established variables in a latent factor is .6, for more newly established and relatively untested measures, a factor loading of .5 is considered sufficient (Awang, 2014). Therefore, if any factor loadings of observed variables onto the latent equanimity factor are less than .5, they were intended to be removed from the analysis, and the theoretical approach towards developing an equanimity latent factor reconsidered.

For each facet, the path coefficients significantly differed from zero, indicating the equanimity latent factor significantly contributed to each subscale. Each of the factor loadings was above the .50 a priori cutoff and reached statistical significance. Therefore, like the results of Juneau et al. (2020), the theoretically guided equanimity latent variable generated from the shared variance of the Nonjudging, Nonreactivity, and modified Acting with Awareness facets was considered viable and used in the main analyses. R-squared ($r^2$) was also reported as an outcome of the CFA. Typically, $r^2$ is considered the proportion of variance of an outcome explained by the predictors of said outcome. Within the context of CFA, the observed variables are the outcomes, generated by the common,
latent factor. In the proposed CFA, the $r^2$ estimate indicated the proportion of variance within the observed FFMQ facets explained by the Equanimity latent variable (see Figure 8).

**Figure 8**

*Equanimity Confirmatory Factor Analysis Results*

![Equanimity CFA Diagram](image)

*Note.* Figure 8 reports CFA factor loadings and path diagram. The standardized loadings of each facet onto the latent Equanimity factor were as follows: Acting with Awareness, $\lambda = 0.685 (0.056)$, $p < 0.001$, $r^2 = 0.469 (0.077)$, $p < 0.001$; Nonjudging, $\lambda = 0.719 (0.057)$, $p < 0.001$, $r^2 = 0.517 (0.077)$, $p < 0.001$; and Nonreactivity, $\lambda = 0.594 (0.056)$, $p < 0.001$, $r^2 = 0.353 (0.067)$, $p < 0.001$. 

60
Research Question 1 Results

To test if stress moderates the predictive relationship between equanimity and BP, three different regression models were tested: an a-priori full model in which a latent equanimity variable predicts BP including stress as an interaction term, an empty model matching the above discussed conceptualizations of equanimity, in which a latent equanimity variable predicts BP without stress added as an interaction term, and an alternate model, which instead treated stress as a confounder of the relationship between equanimity and BP. Pooled correlations between model variables for both the separate SBP and DBP models are shown in Table 3.
Table 3

Pooled Correlation Matrix for SBP/DBP Models, Research Question 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>AWA</th>
<th>NJ</th>
<th>NR</th>
<th>SBP</th>
<th>Stress</th>
<th>Age</th>
<th>Gender</th>
<th>SES</th>
<th>BMI</th>
<th>FH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP Model</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td>SBP</td>
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<tr>
<td>Stress</td>
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<tr>
<td>Age</td>
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<td>0.067</td>
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</tr>
<tr>
<td>Gender</td>
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<td>-0.138</td>
<td>0.144</td>
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<td>NJ</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NR</td>
<td>0.405</td>
<td>0.427</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>0.120</td>
<td>0.151</td>
<td>-0.005</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>-0.437</td>
<td>-0.584</td>
<td>-0.498</td>
<td>0.002</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.095</td>
<td>0.284</td>
<td>0.176</td>
<td>0.044</td>
<td>-0.225</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-0.081</td>
<td>-0.019</td>
<td>-0.048</td>
<td>-0.036</td>
<td>0.144</td>
<td>0.175</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>-0.028</td>
<td>0.123</td>
<td>-0.015</td>
<td>0.034</td>
<td>-0.019</td>
<td>0.222</td>
<td>-0.019</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.034</td>
<td>0.037</td>
<td>0.092</td>
<td>0.121</td>
<td>0.049</td>
<td>-0.074</td>
<td>0.050</td>
<td>-0.016</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FH</td>
<td>-0.102</td>
<td>0.007</td>
<td>0.055</td>
<td>0.049</td>
<td>-0.013</td>
<td>0.122</td>
<td>0.103</td>
<td>0.078</td>
<td>-0.072</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. N = 296. AWA = Acting with Awareness; NJ = Nonjudging; NR = Nonreactivity; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; SES = Socioeconomic Status; BMI = Body Mass Index; FH = Family History of HTN.

MPLUS 8.4 does not compute significance values for the correlation tables generated when predicting imputed models including latent variables, so significant correlation values could not be identified or labeled in this table.
As shown in Table 4, while both the empty model and alternate model with stress as a confounding variable overall showed appropriate model fit, the strongest fit to the predicted model was present in the alternate model. Results of the log-likelihood ratio test indicated the a-priori model with the latent interaction showed poorer fit than the alternate model, but did not significantly differ from the empty model, which excluded stress entirely. AIC and BIC values were similar the log-likelihood ratio test findings, indicating the alternate model had the strongest fit. Detailed results are reported for a-priori, empty, and alternate models below.
Table 4

Fit and Log-Likelihood Ratio Test (LRT) Statistics of Research Question 1

<table>
<thead>
<tr>
<th></th>
<th>SBP</th>
<th></th>
<th>DBP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CFI</td>
<td>CI</td>
<td>Value</td>
<td>CI</td>
</tr>
<tr>
<td>Empty Model</td>
<td>0.937</td>
<td></td>
<td>0.914</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RMSEA</td>
<td>0.051</td>
<td>0.014 0.082</td>
<td>0.058 0.026 0.088</td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-3769.658</td>
<td>-3676.073</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AIC</td>
<td>7577.316</td>
<td></td>
<td>7390.145</td>
</tr>
<tr>
<td></td>
<td>BIC</td>
<td>7647.433</td>
<td></td>
<td>7460.262</td>
</tr>
<tr>
<td>LRT vs. Alternate Model</td>
<td>149.45*</td>
<td>152.176*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRT vs. Full Model</td>
<td>2.56</td>
<td>5.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CFI</td>
<td>0.934</td>
<td></td>
<td>0.955</td>
</tr>
<tr>
<td>Alternate Model</td>
<td>RMSEA</td>
<td>0.062</td>
<td>0.034 0.090</td>
<td>0.051 0.018 0.080</td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-3694.933</td>
<td>-3599.985</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AIC</td>
<td>7431.856</td>
<td></td>
<td>7241.970</td>
</tr>
<tr>
<td></td>
<td>BIC</td>
<td>7509.363</td>
<td></td>
<td>7319.467</td>
</tr>
<tr>
<td>LRT vs. Full Model</td>
<td>-146.89*</td>
<td>-147.172*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CFI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-Priori Full Model</td>
<td>Value</td>
<td>SD</td>
<td>Value</td>
<td>SD</td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-3768.378</td>
<td>7.811</td>
<td>-3673.571</td>
<td>7.847</td>
</tr>
<tr>
<td></td>
<td>AIC</td>
<td>7578.756</td>
<td></td>
<td>7389.143</td>
</tr>
<tr>
<td></td>
<td>BIC</td>
<td>7656.254</td>
<td></td>
<td>7466.640</td>
</tr>
</tbody>
</table>

**p < .001.

Note. Values with the strongest fit statistics across the three models tested for research question 1 are shown in bold above. CFI and RMSEA values which met or exceeded model fit criterion are shown in italics.

When examining the a-priori model (see Table 5), the theorized interaction between equanimity and level of stress was not significant, indicating that stress did not moderate the relationship between equanimity and BP. Instead, contrary to hypotheses, when accounting for covariates and confounders, higher equanimity predicted higher SBP such that for every one-standard deviation increase in equanimity, SBP increased by
0.922 mmHg (B = 0.922, SE = 0.464, CI [0.013, 1.831], p = 0.047). Higher equanimity also significantly predicted higher DBP, such that for every one standard deviation increase in equanimity, DBP increased by 0.701 mmHg (B = 0.701; SE = .323, CI [0.068, 1.333] p = .030).

### Table 5

**Main Results for Research Question 1, Variables Predicting BP in A-priori Model**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th>Predicting DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Equanimity</td>
<td>0.922*</td>
<td>0.464</td>
</tr>
<tr>
<td>Stress</td>
<td>0.119</td>
<td>0.128</td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.030</td>
<td>0.032</td>
</tr>
<tr>
<td>Age</td>
<td>0.061</td>
<td>0.055</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.877*</td>
<td>1.258</td>
</tr>
<tr>
<td>SES</td>
<td>-0.393</td>
<td>0.336</td>
</tr>
<tr>
<td>BMI</td>
<td>0.447*</td>
<td>0.132</td>
</tr>
<tr>
<td>Family History</td>
<td>1.192</td>
<td>1.282</td>
</tr>
</tbody>
</table>

*p ≤ .05

*Note.* Of the covariates of BP, female gender significantly predicted lower SBP, and higher BMI predicted higher SBP. No covariates predicted DBP.

This result was probed by testing equanimity predicting BP at three levels of stress, one standard deviation below the mean, at the mean, and at one standard deviation above the mean, as shown in Table 6 and visualized in Figure 9 for SBP, below. When the levels of stress were varied, no changes in the significance of the B values occurred. Thus, it can be inferred higher or lower levels of stress did not change the predictive relationship of equanimity and BP.
Table 6

*Simple Slopes Analysis of Equanimity on BP Across Levels of Stress*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th>Predicting DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>One SD below mean</td>
<td>0.952</td>
<td>0.473</td>
</tr>
<tr>
<td>At the mean</td>
<td>0.922</td>
<td>0.464</td>
</tr>
<tr>
<td>One SD above mean</td>
<td>0.892</td>
<td>0.457</td>
</tr>
</tbody>
</table>

*p ≤ .05

Figure 9

*Equanimity Predicting SBP Across Levels of Stress*
When examining the empty model, without an interaction term, or stress as a confounder, higher equanimity again significantly predicted higher SBP, such that for every one standard deviation increase in equanimity, SBP increased by 0.679 mmHg (B = 0.679, SE = .304, CI [0.082, 1.275], p = .026), but this effect was smaller and did not reach significance in DBP (B = .382, SE = .210, CI [-0.031, 0.794], p = .070). Table 7 lists results of equanimity, covariates, and confounding variables predicting BP.

Table 7

*Main Results for Research Question 1, Variables Predicting BP in Empty Model*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th></th>
<th>Predicting DBP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Equanimity</td>
<td>0.679*</td>
<td>0.304</td>
<td>0.382</td>
<td>0.210</td>
</tr>
<tr>
<td>Age</td>
<td>0.058</td>
<td>0.059</td>
<td>0.004</td>
<td>0.041</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.627*</td>
<td>1.304</td>
<td>-0.723</td>
<td>0.940</td>
</tr>
<tr>
<td>SES</td>
<td>-0.363</td>
<td>0.349</td>
<td>0.072</td>
<td>0.249</td>
</tr>
<tr>
<td>BMI</td>
<td>0.463*</td>
<td>0.131</td>
<td>0.202</td>
<td>0.096</td>
</tr>
<tr>
<td>Family History</td>
<td>1.101</td>
<td>1.480</td>
<td>1.085</td>
<td>1.044</td>
</tr>
</tbody>
</table>

Note. Of the covariates of BP, female gender significantly predicted lower SBP, and higher BMI predicted higher SBP. No covariates predicted DBP.

*p ≤ .05

When examining the alternate model, wherein stress was treated as a confounder of equanimity and BP, higher equanimity again independently predicted higher SBP, such that for every one standard deviation increase in equanimity, SBP increased by 1.226 mmHg (B = 1.226, SE = 0.558, CI [0.131, 2.320], p = 0.028). Higher equanimity
also predicted higher DBP, such that for every one standard deviation increase, DBP increased by 0.952 mmHg (B = 0.952, SE = .400, CI [0.168, 1.736], p = .017). Table 8 displays the results of equanimity, covariates, and confounding variables predicting BP. Higher stress significantly predicted lower equanimity in the SBP (B = -0.297, SE = 0.033, CI [-0.362, -0.232], p < 0.001) and DBP (B = -0.300, SE = .033, CI [-0.385, -0.235], p < 0.001) models. Stress did not significantly predict SBP (B = 0.289, SE = 0.201, CI [0.104, 0.683], p = 0.150), but did significantly predict higher DBP (B = 0.308, SE = .142, CI [0.029, 0.587], p = 0.030).

**Table 8**

*Main Results for Research Question 1, Variables Predicting BP in Alternate Model*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th>Predicting DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Equanimity</td>
<td>1.226*</td>
<td>0.558</td>
</tr>
<tr>
<td>Stress</td>
<td>0.289</td>
<td>0.201</td>
</tr>
<tr>
<td>Age</td>
<td>0.060</td>
<td>0.059</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.838*</td>
<td>1.327</td>
</tr>
<tr>
<td>SES</td>
<td>-0.401</td>
<td>0.355</td>
</tr>
<tr>
<td>BMI</td>
<td>0.450*</td>
<td>0.132</td>
</tr>
<tr>
<td>Family History</td>
<td>1.118</td>
<td>1.479</td>
</tr>
</tbody>
</table>

*Note.* Of the covariates of BP, female gender significantly predicted lower SBP, and higher BMI predicted higher SBP. Higher stress significantly predicted higher DBP.

*p ≤ .05
Taken together, the results of research question 1 indicated higher equanimity predicted higher SBP and DBP, and stress did not moderate these relationships.

**Research Question 2 Results**

Within research question 1, the alternate model which included stress as a confounder showed superior fit to the main model including stress as a moderator. Therefore, two competing models were built for research question 2: a model of equanimity predicting BP including stress as a moderator, and either rumination or suppression as a mediator, and a model of equanimity predicting BP including stress as an additional confounding variable, and either rumination or suppression as a mediator. The same empty model without a stress variable or either rumination or suppression as a mediator, as utilized in research question 1, was used again to calculate CFI and RSMEA statistics, and to compare the log-likelihood, AIC, and BIC against the two competing models for research question 2.

As shown in Table 9, the a-priori rumination model, in which equanimity predicted BP including stress as a moderator, and rumination as a mediator while accounting for confounders, showed poorer fit to the observed data compared with both the empty model and alternate model. While the empty and alternate models both showed appropriate model fit, the strongest fit to the predicted model was present in the alternate model. Results of the log-likelihood ratio test indicated the a-priori model with the latent interaction showed poorer fit then both the empty and alternate models. AIC and BIC values were similar the log-likelihood ratio test findings, indicating the alternate model
had the strongest fit. Therefore, the results of the alternate model were again evaluated and reported.

Table 9

Fit and Log-likelihood Ratio Test (LRT) Statistics of Research Question 2 for Rumination

<table>
<thead>
<tr>
<th></th>
<th>SBP</th>
<th></th>
<th>DBP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFI</td>
<td>0.937</td>
<td></td>
<td>0.914</td>
<td></td>
</tr>
<tr>
<td>RMSEA</td>
<td>0.051</td>
<td>0.014</td>
<td>0.082</td>
<td>0.058</td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-3769.658</td>
<td></td>
<td>-3676.073</td>
<td></td>
</tr>
<tr>
<td>AIC</td>
<td>7577.316</td>
<td></td>
<td>7390.145</td>
<td></td>
</tr>
<tr>
<td>BIC</td>
<td>7647.433</td>
<td></td>
<td>7460.262</td>
<td></td>
</tr>
<tr>
<td>LRT vs. Alternate</td>
<td>831.098*</td>
<td></td>
<td>832.84*</td>
<td></td>
</tr>
<tr>
<td>LRT vs. Full Model</td>
<td>615.056*</td>
<td></td>
<td>616.244*</td>
<td></td>
</tr>
<tr>
<td>Alternate Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFI</td>
<td><strong>0.968</strong></td>
<td></td>
<td><strong>0.965</strong></td>
<td></td>
</tr>
<tr>
<td>RMSEA</td>
<td><strong>0.048</strong></td>
<td>0.026</td>
<td>0.078</td>
<td><strong>0.049</strong></td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td><strong>-3354.109</strong></td>
<td></td>
<td><strong>-3256.653</strong></td>
<td></td>
</tr>
<tr>
<td>AIC</td>
<td><strong>6758.218</strong></td>
<td></td>
<td><strong>6563.306</strong></td>
<td></td>
</tr>
<tr>
<td>BIC</td>
<td><strong>6771.194</strong></td>
<td></td>
<td><strong>6655.565</strong></td>
<td></td>
</tr>
<tr>
<td>LRT vs. Full Model</td>
<td><strong>-216.042</strong></td>
<td></td>
<td><strong>-216.596</strong></td>
<td></td>
</tr>
<tr>
<td>A-Priori Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-3462.130</td>
<td>8.121</td>
<td>-3364.951</td>
<td>8.375</td>
</tr>
<tr>
<td>AIC</td>
<td>6974.260</td>
<td>16.242</td>
<td>6779.901</td>
<td>16.750</td>
</tr>
<tr>
<td>BIC</td>
<td>7066.519</td>
<td>16.242</td>
<td>6872.160</td>
<td>16.750</td>
</tr>
</tbody>
</table>

Note. Values with the strongest fit statistics across the models tested for research question 2 are shown in bold above. CFI and RMSEA values which met or exceeded model fit criterion are shown in italics. LRT = Log-likelihood Ratio Test.

*p <.001.
As shown in Table 10, the a-priori suppression model, in which equanimity predicted BP including stress as a moderator, and suppression as mediator while accounting for covariates and confounders, showed poorer fit to the observed data compared with both the empty model and alternate model. While the empty and alternate models again both showed appropriate model fit, the strongest fit to the predicted model was present in the empty model. Results of the log-likelihood ratio test indicated the a-priori model with the latent interaction showed poorer fit then both the empty and alternate models. AIC and BIC values were similar the log-likelihood ratio test findings, indicating the empty model had the strongest fit.
Table 10

*Fit and Log-Likelihood Ratio Test (LRT) Statistics of Research Question 2 for Suppression*

<table>
<thead>
<tr>
<th></th>
<th>SBP</th>
<th>DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFI</td>
<td>0.937</td>
<td>0.914</td>
</tr>
<tr>
<td>RMSEA</td>
<td>0.051</td>
<td>0.058</td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-3769.658</td>
<td>-3676.073</td>
</tr>
<tr>
<td>AIC</td>
<td>7577.316</td>
<td>7390.145</td>
</tr>
<tr>
<td>BIC</td>
<td>7647.433</td>
<td>7460.262</td>
</tr>
<tr>
<td>LRT vs. Alternate</td>
<td>-1637.982*</td>
<td>-1634.766*</td>
</tr>
<tr>
<td>LRT vs. Full Model</td>
<td>-1783.916*</td>
<td>-1783.542*</td>
</tr>
<tr>
<td>Alternate Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFI</td>
<td>0.910</td>
<td>0.901</td>
</tr>
<tr>
<td>RMSEA</td>
<td>0.063</td>
<td>0.065</td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-4588.649</td>
<td>-4493.456</td>
</tr>
<tr>
<td>AIC</td>
<td>9227.298</td>
<td>9036.912</td>
</tr>
<tr>
<td>BIC</td>
<td>9319.557</td>
<td>9129.171</td>
</tr>
<tr>
<td>LRT vs. Full Model</td>
<td>-145.934*</td>
<td>-148.776*</td>
</tr>
<tr>
<td>A-Priori Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loglikelihood value</td>
<td>-4661.616</td>
<td>-4567.844</td>
</tr>
<tr>
<td>AIC</td>
<td>9373.233</td>
<td>9185.688</td>
</tr>
<tr>
<td>BIC</td>
<td>9465.492</td>
<td>9277.947</td>
</tr>
</tbody>
</table>

*Note.* Values with the strongest fit statistics across the models tested for research question 2 are shown in bold above. CFI and RMSEA values which met or exceeded model fit criterion are shown in italics. LRT = Log-likelihood Ratio Test.

*p <.001.*

When examining the a-priori model for rumination, accounting for covariates and confounders, the theorized interaction between equanimity and level of stress, and rumination as a mediator, Baron and Kenny’s assumptions for mediation were not met.
While equanimity predicted higher SBP such that for every one standard deviation increase in equanimity, SBP increased by 0.914 mmHg, this relationship between equanimity and SBP did not reach significance (B = 0.913, SE = 0.650, 95% CI [-0.362, 2.187], p = 0.160). Though the relationship between equanimity and rumination reached significance, with higher equanimity predicting slightly lower rumination (B = -0.034, SE = 0.003, 95% CI [-0.041, -0.028], p < 0.001), the relationship between rumination and SBP was not significant (B = -0.080, SE = 0.132, 95% CI [-0.339, 0.178], p = 0.543).

Rumination did not mediate the relationship between SBP and equanimity (Indirect effect B = 0.275, SE = 0.449, 95% CI [-0.605, 1.155], p=0.540).

Similarly, while higher equanimity predicted higher DBP such that for every one standard deviation increase in equanimity, DBP increased by 0.559 mmHg, the relationship did not reach significance (B = 0.559, SE = 0.467, [-0.357, 1.328], p = 0.231). Though the relationship between equanimity and rumination remained significant (B = -0.034, SE = 0.003, 95% CI [-0.041, -0.027], p < 0.001), the relationship between rumination and DBP did not reach significance (B = -0.125, SE = 0.094, 95% CI [-0.308, 0.059], p = 0.184). Rumination did not mediate the relationship between DBP and equanimity (Indirect effect B = 0.422, SE = 0.317, 95% CI [-0.199, 1.044], p=0.183).
Table 11

Main Results for Research Question 2, Variables Predicting BP in A-priori Model for Rumination

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Predicting DBP</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>B</td>
<td>SE</td>
<td></td>
<td>B</td>
<td>SE</td>
<td></td>
</tr>
<tr>
<td>Equanimity</td>
<td>0.913*</td>
<td>0.650</td>
<td>0.559*</td>
<td>0.467</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>0.249</td>
<td>0.152</td>
<td>0.313*</td>
<td>0.104</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.033</td>
<td>0.030</td>
<td>-0.020</td>
<td>0.019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rumination</td>
<td>-0.080</td>
<td>0.132</td>
<td>-0.125</td>
<td>0.094</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.060</td>
<td>0.053</td>
<td>0.007</td>
<td>0.039</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-3.928*</td>
<td>1.234</td>
<td>-1.114</td>
<td>0.892</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>-0.490</td>
<td>0.328</td>
<td>-0.063</td>
<td>0.255</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.456*</td>
<td>0.132</td>
<td>0.194</td>
<td>0.087</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family History</td>
<td>1.266</td>
<td>1.287</td>
<td>1.235</td>
<td>0.990</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Of the covariates of BP, female gender significantly predicted lower SBP, and higher BMI predicted higher SBP. Higher stress significantly predicted higher DBP.

*p ≤ .05

When examining the a-priori model for suppression, accounting for confounders, the theorized interaction between equanimity and level of stress, and suppression as a mediator, Baron and Kenny’s assumptions for mediation were again not met. Though higher equanimity again significantly predicted higher SBP such that for every one standard deviation increase in equanimity, SBP increased by 0.960 mmHg (B = 0.960, SE = 0.447, 95% CI [0.083, 1.836], p = 0.032) and the relationship between equanimity and suppression also reached significance (B = -0.380, SE = 0.164, 95% CI [-0.701, -0.059], p = 0.020), the relationship between suppression and SBP did not reach significance (B = -0.121, SE = 0.140, 95% CI [-0.395, 0.152], p = 0.385). Suppression did not mediate the
relationship between SBP and equanimity (Indirect effect B = 0.047, SE = 0.056, 95% CI [-0.064, 0.157], p=0.342).

The predictive relationship between equanimity and DBP did not reach significance (B = 0.918, SE = 0.746, 95% CI [-0.544, 2.379], p = 0.218), nor did the predictive relationship between equanimity and suppression (B = -0.492, SE = 0.474, 95% CI [-1.422, 0.438], p = 0.300), or the predictive relationship between suppression and DBP (B = -0.082, SE = 0.096, 95% CI [-0.271, 0.107], p = 0.397). Suppression did not mediate the predictive relationship between DBP and equanimity (Indirect effect B = 0.046, SE = 0.085, 95% CI [-0.121, 0.213], p=0.589).

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th></th>
<th>Predicting DBP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Equanimity</td>
<td>0.960*</td>
<td>0.447</td>
<td>0.918*</td>
<td>0.746</td>
</tr>
<tr>
<td>Stress</td>
<td>0.135</td>
<td>0.137</td>
<td>0.177*</td>
<td>0.097</td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.033</td>
<td>0.034</td>
<td>-0.024</td>
<td>0.036</td>
</tr>
<tr>
<td>Suppression</td>
<td>-0.380</td>
<td>0.164</td>
<td>-0.082</td>
<td>0.096</td>
</tr>
<tr>
<td>Age</td>
<td>0.058</td>
<td>0.054</td>
<td>0.009</td>
<td>0.040</td>
</tr>
<tr>
<td>Gender</td>
<td>-4.259*</td>
<td>1.280</td>
<td>-1.339</td>
<td>0.938</td>
</tr>
<tr>
<td>SES</td>
<td>-0.421</td>
<td>0.336</td>
<td>-0.017</td>
<td>0.263</td>
</tr>
<tr>
<td>BMI</td>
<td>0.459*</td>
<td>0.133</td>
<td>0.190*</td>
<td>0.088</td>
</tr>
<tr>
<td>Family History</td>
<td>1.313</td>
<td>1.286</td>
<td>1.256</td>
<td>1.021</td>
</tr>
</tbody>
</table>

*p ≤ .05
When examining the alternate model for rumination, accounting for confounders (including stress as a confounder instead of a moderator) and rumination as a mediator, Baron and Kenny’s assumptions for mediation were again not met. The predictive relationship between equanimity and SBP did not reach significance ($B = 1.460$, $SE = 1.093$, 95% CI $[-0.691, 3.611]$, $p = 0.183$), and though the predictive relationship between equanimity and rumination reached significance ($B = -0.038$, $SE = 0.004$, 95% CI $[-0.046, -0.031]$, $p < 0.001$), the predictive relationship between rumination and SBP did not ($B = -0.033$, $SE = 0.163$, 95% CI $[-0.353, 0.287]$, $p = 0.841$). Rumination did not mediate the predictive relationship between SBP and equanimity (Indirect effect $B = 0.126$, $SE = 0.126$, 95% CI $[-1.101, 1.353]$, $p=0.841$).

Similarly, the predictive relationship between equanimity and DBP did not reach significance ($B = 0.925$, $SE = 0.785$, 95% CI $[-0.613, 2.463]$, $p = 0.239$), and though predictive relationship between equanimity and rumination remained significant ($B = -0.038$, $SE = 0.004$, 95% CI $[-0.046, -0.030]$, $p < 0.001$), the predictive relationship between rumination and DBP did not reach significance ($B = -0.092$, $SE = 0.116$, 95% CI $[-0.320, 0.136]$, $p = 0.430$). Rumination did not mediate the predictive relationship between DBP and equanimity in the alternate model for rumination (Indirect effect $B = 0.349$, $SE = 0.444$, 95% CI $[-0.521, 1.219]$, $p=0.432$).
Table 13

**Main Results of Research Question 2, Variables Predicting BP in Alternate Model for Rumination**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th>Predicting DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Equanimity</td>
<td>1.460</td>
<td>1.098</td>
</tr>
<tr>
<td>Stress</td>
<td>0.414</td>
<td>0.226</td>
</tr>
<tr>
<td>Rumination</td>
<td>-0.033</td>
<td>0.163</td>
</tr>
<tr>
<td>Age</td>
<td>0.058</td>
<td>0.059</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.916*</td>
<td>1.319</td>
</tr>
<tr>
<td>SES</td>
<td>-0.524</td>
<td>0.355</td>
</tr>
<tr>
<td>BMI</td>
<td>0.460*</td>
<td>0.131</td>
</tr>
<tr>
<td>Family History</td>
<td>1.162</td>
<td>1.473</td>
</tr>
</tbody>
</table>

*p ≤ .05

When examining the alternate model for suppression, accounting for confounders, the theorized interaction between equanimity and level of stress, and suppression as a mediator, Baron and Kenny’s assumptions for mediation were not met. Although the predictive relationship between equanimity and SBP (B = 1.202, SE = 0.557, 95% CI [0.109, 2.294], p = 0.029), and the predictive relationship between equanimity and suppression reached significance (B = -0.341, SE = 0.125, 95% CI [-0.586, -0.096], p = 0.006), the predictive relationship between suppression and SBP did not reach significance (B = -0.126, SE = 0.143, 95% CI [-0.407, 0.155], p = 0.380). Suppression did not mediate the predictive relationship between SBP and equanimity in the alternate model (Indirect effect B = 0.044, SE = 0.051, 95% CI [-0.057, 0.144], p=0.397).

Similarly, while the predictive relationship between equanimity and DBP reached significance (B = 0.931, SE = 0.399, 95% CI [-0.096, 1.712], p = 0.020) and the predictive relationship between equanimity and suppression (B = -0.338, SE = 0.124,
95% CI [-0.581, -0.096], \( p = 0.006 \) reached significance, the predictive relationship between suppression and DBP (\( B = -0.107, \ SE = 0.103, \) 95% CI [-0.310, 0.096], \( p = 0.303 \)) did not. Suppression did not mediate the predictive relationship between DBP and equanimity in the alternate model (Indirect effect \( B = 0.036, \ SE = 0.037, \) 95% CI [-0.037, 0.109], \( p=0.329 \)).

### Table 14

**Main Results for Research Question 2, Variables Predicting BP in Alternate Model for Suppression**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th>Predicting DBP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Equanimity</td>
<td>1.202*</td>
<td>0.557</td>
</tr>
<tr>
<td>Stress</td>
<td>0.285</td>
<td>0.198</td>
</tr>
<tr>
<td>Suppression</td>
<td>-0.126</td>
<td>0.143</td>
</tr>
<tr>
<td>Age</td>
<td>0.056</td>
<td>0.059</td>
</tr>
<tr>
<td>Gender</td>
<td>-4.211*</td>
<td>1.369</td>
</tr>
<tr>
<td>SES</td>
<td>-0.415</td>
<td>0.356</td>
</tr>
<tr>
<td>BMI</td>
<td>0.463*</td>
<td>0.463</td>
</tr>
<tr>
<td>FH</td>
<td>1.244</td>
<td>1.480</td>
</tr>
</tbody>
</table>

\* = \( p \leq .05 \)

Taken together, the results of research question 2 indicated neither rumination nor suppression mediated the relationship between equanimity and either SBP or DBP.
Research Question 3 Results

A moderated multiple regression was completed to test if the interaction of mindful awareness and acceptance predict BP after controlling for theorized confounders and covariates. A pooled correlation matrix for these analyses is shown in Table 15. The overall models for SBP ($r^2 = 0.108$, $F(8, 215) = 3.255, p = 0.002$) reached significance, while the overall model for DBP ($r^2 = 0.041$, $F(8, 215) = 1.136, p = 0.341$) did not.

Table 15

Pooled Correlation Matrix, Research Question 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>SBP</th>
<th>DBP</th>
<th>Gender</th>
<th>FH</th>
<th>Age</th>
<th>SES</th>
<th>BMI</th>
<th>OBS</th>
<th>ACC</th>
<th>INT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBP</td>
<td>0.698*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-0.140*</td>
<td>-0.036</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FH</td>
<td>0.016</td>
<td>0.048</td>
<td>0.103*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.058</td>
<td>0.042</td>
<td>0.177*</td>
<td>0.122*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>-0.039</td>
<td>0.034</td>
<td>-0.012</td>
<td>0.088</td>
<td>0.221*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.189*</td>
<td>0.119*</td>
<td>0.051</td>
<td>-0.075</td>
<td>-0.078</td>
<td>-0.023</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBS</td>
<td>-0.044</td>
<td>-0.056</td>
<td>0.121*</td>
<td>-0.019</td>
<td>0.061</td>
<td>-0.014</td>
<td>-0.086</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACC</td>
<td>0.164*</td>
<td>0.101*</td>
<td>-0.035</td>
<td>0.030</td>
<td>0.275*</td>
<td>0.069</td>
<td>0.069</td>
<td>0.167*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>INT</td>
<td>-0.023</td>
<td>-0.060</td>
<td>0.079</td>
<td>0.009</td>
<td>0.012</td>
<td>-0.056</td>
<td>-0.061</td>
<td>0.082</td>
<td>0.054</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. N = 296. SBP = Systolic Blood Pressure; FH = Family History of Hypertension; SES = Socioeconomic Status; BMI = Body Mass Index; OBS = Observing; ACC = Acceptance; INT = Observing x Acceptance interaction term

*p < 0.05
The analysis contained three blocks, the first including confounders and covariates. These variables accounted for a significant amount of variance in SBP ($r^2 = 0.097$, $F(5, 218) = 4.706$, $p < 0.001$, range across imputed models [< 0.001, 0.002, 50/50 significant]) but not in DBP ($r^2 = 0.032$, $F(5, 218) = 1.464$, $p = 0.203$, range across imputed models [0.088, 0.457, 0/50 significant]). Gender ($B = -3.973$, $t(296) = -3.008$, $p = 0.003$) and BMI ($B = 0.485$, $t(296) = 3.601$, $p < 0.001$) significantly predicted SBP, while only BMI ($B = 0.214$, $t(296) = 2.180$, $p = 0.029$) significantly predicted DBP. Family history of HTN, age, and SES were not significant predictors of either form of BP.

The second step included the Observing and Acceptance variables, which did not significantly add to the amount of variance explained by the model for SBP ($\Delta r^2 = 0.001$, $\Delta F(2, 216) = 1.227$, $p = 0.295$, range across imputed models [< 0.002, 0.295, 13/50 significant]) or DBP ($\Delta r^2 = 0.010$, $\Delta F(2, 216) = 0.138$, $p = 0.872$, range across imputed models [< 0.040, 0.827, 1/50 significant]). Acceptance significantly predicted higher SBP ($B = 0.155$, $t(296) = 2.072$, $p = 0.038$), though not higher DBP ($B = 0.074$, $t(296) = 1.026$, $p = 0.176$). Observing was not a significant predictor of either SBP or DBP.

The final block included the Observing and Acceptance interaction term. This interaction term did not account for a significant amount of added variance in SBP ($\Delta r^2 < 0.001$, $\Delta F(1, 215) = 0.115$, $p = 0.734$, range across imputed models [0.485, 0.948, 0/50 significant]) or DBP ($\Delta r^2 = 0.007$, $\Delta F(1, 215) = 1.532$, $p = 0.215$, range across imputed models [0.129, 0.950, 0/50 significant]), nor did it predict either SBP or DBP, as shown in Table 16. These results were further probed using simple slopes analyses, with results
emphasizing the similarity in B across both lower and higher levels of the Observing and Acceptance interaction, shown in Table 17.

Table 16

*Main Results for Research Question 3, Variables Predicting BP*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>SBP B</th>
<th>SBP SE</th>
<th>DBP B</th>
<th>DBP SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observing</td>
<td>-0.072</td>
<td>0.128</td>
<td>-0.076</td>
<td>0.091</td>
</tr>
<tr>
<td>Acceptance</td>
<td>0.156</td>
<td>0.075</td>
<td>0.077</td>
<td>0.055</td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.002</td>
<td>0.011</td>
<td>-0.007</td>
<td>0.008</td>
</tr>
<tr>
<td>Age</td>
<td>0.068</td>
<td>0.056</td>
<td>0.016</td>
<td>0.041</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.583*</td>
<td>1.341</td>
<td>-0.596</td>
<td>0.968</td>
</tr>
<tr>
<td>SES</td>
<td>-0.378</td>
<td>0.357</td>
<td>0.065</td>
<td>0.253</td>
</tr>
<tr>
<td>BMI</td>
<td>0.446*</td>
<td>0.137</td>
<td>0.186</td>
<td>0.100</td>
</tr>
<tr>
<td>FH</td>
<td>0.974</td>
<td>1.531</td>
<td>0.943</td>
<td>1.063</td>
</tr>
</tbody>
</table>

*p ≤ .05
Table 17

Effects of Interaction of Observing and Acceptance on BP Across Levels of Acceptance

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Predicting SBP</th>
<th></th>
<th>Predicting DBP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>One SD below mean</td>
<td>-0.011</td>
<td></td>
<td>-0.072*</td>
<td></td>
</tr>
<tr>
<td>At the mean</td>
<td>-0.008</td>
<td></td>
<td>-0.051*</td>
<td></td>
</tr>
<tr>
<td>One SD above mean</td>
<td>-0.010</td>
<td></td>
<td>-0.066*</td>
<td></td>
</tr>
</tbody>
</table>

*\(p \leq .05\)

Note. When the simple slopes analysis was run, the predictor variables utilized were not retained in the model due to the linear regression algorithm appearing to identify them as not adding additional significant information to the model. Therefore, SE values were not generated for these predictors, and only the values themselves are reported.

Taken together, the results of research question 3 indicated the interactive effects of mindful Observing and Acceptance did not predict lower BP. Acceptance independently predicted higher SBP, while Observing did not predict either SBP or DBP.
Chapter 4
Discussion

The current study was designed with two goals, across three research questions. The first goal was extending our understanding of how mindfulness, conceptualized both as the interaction of mindful awareness and acceptance posed in MAT, and as equanimity from a Buddhist framework, relate to BP. The second was investigating if stress moderates and emotion regulation strategies mediate the hypothesized relationship between equanimity and BP. The following research questions were tested: (1) Does higher equanimity predict lower BP, and does the strength of the effect of equanimity on BP vary across levels of stress, such that the relationship between equanimity and BP is stronger at higher levels of stress? (2) To what degree is the purported relationship between equanimity and BP explained by rumination and suppression? (3) To what degree does the interaction of mindful awareness and acceptance described in MAT predict BP? This concluding chapter begins with a discussion of the unexpected positive relationships between equanimity and BP, resulting implications regarding the measurement of equanimity and mindfulness as conceptualized in MAT, and the validity of the FFMQ in specific contexts. Implications regarding the moderation and mediation results of the first two aims will also be discussed. Then, various considerations regarding the current state of the field of mindfulness research, the importance of earlier-stage research examining trait mindfulness and a summary of recommendations for future research will be discussed. Finally, the chapter will end with discussion of the limitations of the current study.
Interpretation of Main Results

Contrary to hypotheses, higher equanimity predicted higher BP at baseline among adults enrolled in a multi-site clinical trial of MBSR for prehypertension. In testing the first research question, across all three models, higher equanimity consistently predicted higher, not lower, SBP and DBP, and stress did not moderate these relationships. Though the effect sizes did not reach clinical relevance in any of the models, the effect was most pronounced within the alternate models specifying stress level as a confounding variable rather than as a moderator, and least pronounced in the empty models not including stress at all. The alternate model displayed the best fit to the observed data of the models tested.

In the second research question, higher equanimity again predicted higher BP across the a-priori, empty, and alternate models. Like research question 1, the relationship between equanimity and BP was strongest in the alternate model for both forms of BP, across the models for both rumination and suppression, though again the effect sizes did not reach clinical significance. Neither rumination nor suppression mediated these relationships. The alternate and empty models both showed acceptable fit in the rumination and suppression models. However, the alternate model showed the strongest fit to the observed data across SBP and DBP in the rumination models, whereas the empty model showed the strongest fit in the suppression models.

Finally, though the results of the third research question indicated higher Acceptance independently predicted higher SBP, the interactive effects of mindful Observing and Acceptance did not predict SBP or DBP, and the effect sizes did not reach clinical significance.
In sum, in a sample of meditation naïve adults with on average mildly high to prehypertensive BP and normative stress levels, higher equanimity predicted slightly higher SBP and DBP, but the effects were not clinically significant. Stress did not moderate these relationships. Neither rumination or suppression mediated the relationship between equanimity and either form of BP, and the interactive effects of mindful Observing and Acceptance as postulated within MAT did not predict lower SBP or DBP. Results did not support a link between equanimity, as measured in the current study, and clinic BP. Nor did they support Monitor and Accept Theory (MAT), specifically in the context of the interactive effects of Observing and Acceptance associating with lower BP.

**Considerations Regarding Equanimity**

To begin, several potential explanations for the unexpected positive relationship present between equanimity and BP will be discussed. First, as several items showing DIF in non-meditators within Van dam et al.’s prior study were not removed to maintain study feasibility, as the current study sample consists of non-meditators, it is possible the latent equanimity variable did not adequately capture the concept of equanimity as discussed in Juneau (2021) due to DIF. Second, it is possible that the conceptualization of equanimity reflected in the current study’s latent equanimity variable successfully captured Juneau et al.’s conceptualization of equanimity. In Juneau et al.’s study, equanimity was shown to correspond to the Acting with Awareness, Nonjudging, and Nonreactivity FFMQ facets. Furthermore, equanimity has been previously theorized to underlie mindfulness (Anālayo, 2021; Desbordes et al., 2015). This would indicate capturing equanimity as a latent variable derived from the shared variance of the FFMQ’s
Acting with Awareness, Nonjudging, and Nonreactivity facets as an appropriate analytic strategy, in the absence of a measure specifically targeting equanimity conceptually (Pelham III et al., 2019).

Conceptually, Juneau et al. described equanimity as involving 1) emotional balance and calm despite emotional valence of experiences, and 2) decreased motivational and emotional responses towards pleasant experiences, arising from the decoupling of desire for experiences and hedonic tone (2020). Juneau et al. combined two conceptualizations of equanimity prominent within the empirical literature in their model. In doing so, they designed a more thorough secular model for how equanimity may relate to health when compared with other current prominent models (Hadash et al., 2016; Desbordes et al. 2015).

Still, mindfulness (including equanimity) has been subject to much debate and controversy, particularly regarding its relationship with Buddhist religiosity. It can be argued mindfulness as a secular practice, partially divorced from religious or spiritual context, is more accessible for a broader range of individuals. Others contend mindfulness, when separated from religious accounts linking it to an ethical code of conduct aimed at achieving spiritual enlightenment, cannot be fully understood or realized (Bodhi, 2011). In nonsecular Buddhist texts, characteristics like integrity (living and acting with integrity), and assurance in one’s own actions (faith and conviction in one’s own wisdom) are included as additional core mental qualities fostering the development of equanimity (Fronsdal, 2004).
These specific qualities are not immediately apparent within any of the FFMQ facets, including those noted by Juneau et al. to relate to their conceptualization of equanimity (2020). Therefore, they are not reflected in the equanimity variable used in the current study. In the context of non-meditating samples and in the absence of these elements of equanimity noted in Buddhist but not secular literature, higher ‘equanimity’ as measured in the current study may genuinely predict higher BP. Indeed, early epidemiological evidence seems to indicate certain character traits, particularly integrity, predicts better long-term physical health and well-being, independent of demographics, SES, health conditions, and health behaviors (Weziak-Bialowolska et al., 2019).

Additionally, in the absence of mindfulness training and independent of said ‘secular’ characteristics, items included in the calculation of the equanimity latent variable (“I criticize myself for having irrational or inappropriate emotions”, “I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted”, “When I have distressing thoughts or images, I am able just to notice them without reacting”), may instead be interpreted as detachment from the present moment experience, or experiential avoidance. It has been postulated these items may be misconstrued by non-meditators as a type of inaction or passivity, as they do not account for the active process of re-engaging which acceptance facilitates (Purser, 2019; Choi et al., 2021). Further research replicating the current findings is necessary to validate this prospect. Future studies attempting to measure equanimity may benefit from assessing qualities like integrity, alongside the qualities of hedonic interdependence and even-minded state of mind identified by Juneau et al. (2020). It is possible these ‘secular’ characteristics may be difficult to measure accurately in meditation-naïve respondents, or
even in non-Buddhist mindfulness practitioners. It follows that further exploration of whom this possible future research is targeted towards, and related concerns regarding inclusivity and exclusivity, is needed.

Furthermore, a recent study analyzing the nomological network of mindfulness noted in peer-reviewed publications, researchers tend to emphasize both awareness and acceptance. In comparison, acceptance was not often emphasized in popular press articles (Choi et al., 2021). This suggests laypeople, or informally trained practitioners, may not consider acceptance to be a fundamental aspect of mindfulness, with attentional aspects of mindfulness receiving greater focus. It is possible this lack of emphasis on acceptance in popular definitions of mindfulness causes challenge in adequately conveying acceptance-based elements of trait mindfulness in self-report measures. Laypeople might not recognize acceptance-related items as measures of mindful acceptance, causing measures assessing acceptance to generate results unaligned with the theoretical concept. If this is indeed the case, it is understandable how respondents with lower equanimity might endorse higher scores on these items. This would, in turn, impact the shared variance between the three FFMQ facets which constitutes the latent equanimity variable. As detachment and experiential avoidance are functionally opposite to equanimity, this possible issue of construct validity may have affected the current results (Desbordes et al., 2015).

**Scales Assessing Equanimity**

As research interest in equanimity has increased, several self-report scales attempting to capture equanimity have been published. These include the Equanimity
Scale (EQUA-S) and the Equanimity Scale-16 (ES-16) (Juneau et al, 2020; Rogers et al., 2021). The EQUA-S is a novel self-report measure intended to capture two factors—even minded state of mind, and hedonic interdependence, fitting with Juneau et al.’s (2020) conceptualization of equanimity, which inspired the current study’s latent equanimity variable. Somewhat akin to the current study’s method of capturing equanimity and the EQUA-S, the ES-16 also assesses two factors—experiential acceptance and Nonreactivity. The ES-16 includes items mainly derived from the FFMQ, the Freiburg Mindfulness Inventory, the yet unpublished Multidimensional Mindfulness Inventory, and individual items from several other trait mindfulness scales. The authors of the ES-16 describe this scale as consistent with both MAT and the Decoupling model of equanimity, alongside multiple other models of equanimity and equanimity-ancillary constructs (Rogers et al., 2021).

Although utilization of items from previously published self-report measures in the creation of new measures is common within psychological research, and was in part used in the current study, the validity of a new measure created using items drawn from extant measures may be impacted by the validity of the measures it draws upon. Many trait mindfulness measures have issues with validity. This includes the FFMQ and FMI, which were utilized within the ES-16 (Park et al., 2013). The authors of the first published confirmatory factor analysis of the measure address this, stating since items from the Multidimensional Mindfulness Inventory, which contributed over a third of the items present in the ES-16, were derived from “a very large pool” of items chosen by 13 lead authors in the field of mindfulness research, they do not contribute to item overlap across scales (Rogers et al., 2021; Cheever et al., 2023).
Scientific consensus conferences can be a valuable way to better understand field-wide views on a given topic and may be useful in helping to identify a consensus conceptualization of mindfulness and mindfulness ancillary constructs (Park et al., 2013). However, without transparent discussion of the methodology utilized by these experts, it is unclear exactly how expert discussion decreased the presence of inflated factor loadings within the ES-16. Moreover, because of this lack of transparency, it is unclear if the ES-16 is any more effective at measuring equanimity than other methodologies, like either the EQUA-S, or the methodology used within the current study.

**Considerations Regarding FFMQ Psychometrics**

As completed in the current study, it is common in mindfulness research for FFMQ items, facets, or combinations of FFMQ facets, to be recommended for use in, utilized, or adapted for capturing various conceptualizations of mindfulness and mindfulness-ancillary constructs (Lindsay & Creswell, 2017; Cardaciotto et al., 2008; Duan & Li, 2016; Rogers et al., 2021). As discussed in the introduction of this dissertation, the FFMQ was created from items included in multiple earlier trait mindfulness measures. This process was based off the results of a factor analysis examining these measures (Baer et al., 2006). Multiple confirmatory factor analyses have subsequently validated the factor structure of the FFMQ, with some sample-dependent variation surrounding the inclusion of Observing as a factor (Baer et al., 2006; Baer et al., 2008; Christopher et al., 2012; Curtiss & Klemanski, 2014; Williams et al., 2014).

Factor analyses assess construct validity, e.g. the likelihood a set of items measure a given construct (Knekta et al., 2019). Although factor analysis is a highly useful tool for
assessing this core aspect of validity, it is not immune to error, and other important aspects of validity exist. For example, item overlap likely generating overestimated factor loadings in the initial factor analysis upon which the FFMQ was designed has been identified (Pelham III et al., 2019). Item overlap inflates validity and reliability estimates and obscures the unique contribution of individual items or subscales to the construct of interest. This result presents concern about over-reliance on solely confirmatory factor analysis in ascertaining the construct validity of the FFMQ.

Furthermore, construct validity is not just the likelihood of a set of items accurately measuring a single construct. The specific context in which the use of any measure is intended to occur is also a key aspect of construct validity (Knekta et al., 2019). In particular, examining DIF is a useful but underutilized assessment of construct validity, especially in measures which seem to show differences in psychometric properties across different contexts, or samples—e.g., meditation naïve and experienced meditator samples (Martinková et al., 2017). Given this context, assessing DIF is likely especially important in adequately determining construct validity for the FFMQ. Yet, studies assessing validity of the FFMQ rarely examine DIF. The few studies which have showed disparate results in similar samples. One study indicated DIF was present in numerous FFMQ items (Van Dam et al., 2009), whereas the other, conducted by the original author of the FFMQ, found minimal evidence of DIF (Baer et al., 2011). These mixed results underscore the need for additional validation studies probing DIF in the FFMQ.
Additionally, a recent experimental study tested sensitivity to pre-post MBSR change in the FFMQ, versus an alternate intervention designed to minimally impact trait mindfulness and a waitlist control. This study found FFMQ scores increased across all three conditions. Moreover, the change in FFMQ scores between MBSR and the alternate intervention did not significantly differ (Goldberg et al., 2017). These findings were accentuated by results of a recent meta-analysis examining 20 studies comparing MBIs with active control condition. Of these 20 studies, four included a measure of trait mindfulness (the FFMQ, MAAS, or CAMS-R). Of those four, none showed any differences in change in trait mindfulness between the MBI and active control conditions (Goyal et al., 2014). Given increased trait mindfulness is a key mechanism by which MBIs are said to impact health and well-being, this raises concern regarding the ability of trait mindfulness questionnaires (including the FFMQ) to ascertain trait mindfulness, or alternatively, the validity of this purported mechanism of action (Goldberg et al., 2017).

On balance, despite the wide use and acceptance of the FFMQ as a gold-standard measure of trait mindfulness, the validity of the FFMQ and other self-report measures of trait mindfulness may not be as robust as typically assumed (Van Dam et al., 2009; Goldberg et al., 2017; Goyal et al., 2014; Pelham III et al., 2019). These results indicate potential issues with construct validity, and accentuate the need for further exploration of FFMQ validity. Until these concerns are empirically addressed, equanimity and mindful acceptance and awareness may be best examined using methodologies and measures apart from FFMQ.
Moderation and Mediation Results and Considerations

Apart from the current study, stress as a moderator and rumination and suppression as mediators of the relationship between trait mindfulness and clinic BP remains relatively untested. In the results of research questions one and two respectively, stress did not moderate the relationships between equanimity and either form of BP. Neither rumination nor suppression mediated these relationships. However, it is possible these moderation and mediation results are not valid, given the psychometric concerns regarding the FFMQ discussed above. For this reason, the results of the current study should be hesitantly interpreted. Despite this, these results do meaningfully inform considerations for future research.

To begin, stress was tested as a moderator of the relationship between equanimity and BP due to prior research implying trait mindfulness may only relate to health in the context of higher stress. It has been previously posited in the absence of high stress, trait mindfulness may not modify adverse self-regulatory behaviors associated with higher stress and BP (eg. Emotion regulation strategies) to buffer (Creswell & Lindsay, 2014). As shown in Table 1, participants in the current study on average reported relatively normative levels of perceived stress (within 1-SD). Although stress and BP did not correlate in the current results, it is possible floor effects limited any stress-related moderation present in the relationship between equanimity and BP (Cohen, 1994).

It is also possible that instead of moderating the strength of the relationship between trait mindfulness and BP, stress mediates the relationship between trait mindfulness and BP. In this case, higher trait mindfulness would relate to lower BP
primarily due to mindfulness reducing stress. Previous studies have shown perceived stress partially mediates the relationship between trait mindfulness and perceived physical symptoms of stress, though stress as a mediator of the relationship between trait mindfulness and objective BP in a meditation-naive sample currently remains untested (McBride et al., 2022). The relationship between mindfulness, stress, and BP is complex, likely involves additional variables, and requires further investigation. Although rumination and suppression have strong conceptual ties to both mindfulness (including equanimity) and BP, they are not the only possible mediators of the relationship between trait mindfulness and BP (Larsen & Christenfield, 2009; Quartana & Burns, 2010; Gross, 2014; Peters, 2014; Patel & Patel, 2019).

For example, multiple correlational studies link higher trait mindfulness with engagement in heart-protective health behaviors, including adequate sleep, healthy diet, and higher physical activity, with a recent meta-analysis of 125 studies finding trait mindfulness (measured using eight different scales) had a small but beneficial association with aggregate health behaviors (Loucks et al., 2016; Sala, Rochefort, Lui & Baldwin, 2019; Schuman-Oliver et al. 2020). RCTs have also repeatedly demonstrated beneficial effects of mindfulness trainings on sleep, diet, and physical activity (Gong et al., 2016; Salmoirago-Blotcher, Morgan, Fischer & Carmody, 2013; Kangasniemi et al., 2015; Tapper et al., 2009). And, self-reported changes in diet have been shown to partially mediate significant decreases in SBP and DBP. This implies mindfulness training and interventions (and potential related changes in trait mindfulness) may modestly impact health behaviors (An et al., 2020).
Rumination may also indirectly cause allostatic load via its relationship with health behaviors. Rumination strengthens and prolongs certain aversive mood states like anger, anxiety, and depression, which in turn can lead to higher engagement in poor health behaviors (Nolen-Hoeksema et al., 1993; Bushman; 2002; McLaughlin et al., 2007). The combination of rumination and associated aversive mood states over time may lead to higher impulsivity, defined as the tendency against inhibiting potentially risky behaviors in situations where thoughtful, planned responses are more effective, with decreased recognition of or care about potential negative consequences (Bakhshani et al., 2014).

For example, if an individual tends towards rumination, they may defer appropriate health behavior decision making in favor of ruminating. This may contribute to making quick, impulsive decisions regarding their health behaviors when such decisions ultimately become necessary. Time spent ruminating might directly limit an individual’s available time to prepare healthy meals, with the consequence of instead purchasing fast food to meet dietary needs quickly when hungry. Or, an individual might choose to relax by engaging in easily achievable sedentary activities which take up shorter amounts of time (like playing a mobile game), instead of higher-effort but healthier activities (like physical activity or exercise), which may require leaving the home or workplace, preparation, and potentially more time.

Furthermore, to quickly ameliorate aversive or distressing responses to rumination, an individual may engage in other behaviors which actively harm the cardiovascular system but provide immediate short-term rewards, like smoking, alcohol
use, or other substance use. Although these behaviors can serve as short-term distractions from the distress and negative mood states generated by rumination, they likely cause longer-term harm to physical and mental health, cyclically incite higher engagement in rumination, and may lead to greater accumulated allostatic load (Doron et al., 2014; Hoffman & Hay, 2018). Even when controlling for depression and baseline rumination, self-reported trait rumination has been shown to predict increased trait impulsivity at one-month follow up, with trait impulsivity then cyclically predicting increased trait rumination (Hasegawa et al., 2018). More recent work by the same authors using behavioral measures of impulsive action yielded results further supporting this relationship (Hasegawa et al., 2020), though it remains to be investigated if this finding persists over time.

Another recent study investigating impulsivity as a mediator between trait rumination and engagement in health behaviors found impulsivity significantly mediated the relationships between rumination and alcohol use, as well as rumination and sexually risky behavior. Though the authors found impulsivity did not mediate the relationships between rumination and eating fruits or vegetables, they postulated impulsivity may instead increase intake of unhealthy foods (Riley et al., 2018). Several studies have since demonstrated negative associations between impulsivity and eating fruits and vegetables, as well as positive associations between impulsivity and unhealthy food intake (Benard et al., 2019; Gómez-Martínez et al., 2022)

As rumination involves perseverative cognition on stressors and negative events, it may also cause amotivation, or the loss of motivation to begin or continue in a goal-
directed behavior (Riley et al., 2019). In the context of engaging in positive health behaviors, rumination about prior failed attempts to engage in said behaviors, like successful dieting, regular exercise, or achieving better sleep, may lead an individual towards experiencing feelings of hopelessness and loss of control when considering future engagement in these behaviors. This in turn may cause amotivation, decreasing engagement in said positive health behaviors (Thomsen et al., 2004; Clancy et al., 2016).

Results of one study indicate self-reported daily amotivation may mediate the relationship between rumination and exercise (Riley et al., 2019). Still, the possible link between rumination, amotivation, and health behaviors remains relatively unstudied. This initial result should be interpreted tentatively and not over-generalized. Although the current study did not support rumination or suppression as mediators, replication is necessary to ascertain the legitimacy of these findings. Furthermore, other possible mediators of the relationship between trait mindfulness (including equanimity) and BP exist, like health behaviors. It is plausible these mediators work in tandem and may be best tested using a multiple mediator model.

Understanding the specific causal mechanisms through which mindfulness influences physical health outcomes can support the development of MBIs more effectively targeting said outcomes. Identifying mediators informs intervention design, and specifically targeting established mediators will likely enable greater intervention effectiveness. Taken together, the field of mindfulness research stands to benefit from increased focus on mediators of the relationship between trait mindfulness and aspects of physical health, like BP and other forms of stress-related diseases and illnesses.
Considerations Regarding MAT

In the current study’s third research question, the Observing and the sum of the Nonjudging and Nonreactivity FFMQ facets were combined to calculate mindfulness as conceptualized in MAT (Lindsay & Creswell, 2017). This theory posited a combination of mindful awareness and acceptance drives the beneficial effects of mindfulness on health. Lindsay and Creswell (2017) note how the Observing facet of the FFMQ specifically corresponds with their conceptualization of mindful awareness, and how Observing may have adverse effects in isolation. However, in the present study, the interaction of Observing and acceptance did not predict BP. When examining the Observing and acceptance variables in isolation, Observing had a near zero, negative correlation with clinic BP, whereas the correlation between acceptance (Nonjudging + Nonreactivity) remained modest but was positive and statistically significant.

Akin to equanimity, it is possible the interaction of awareness and acceptance calculated in the current study does not adequately represent the concept of interactive mindful awareness and acceptance postulated in MAT. Variables attempting to capture the interaction of awareness and acceptance a la MAT may function differently in naive-meditating samples. It is widely acknowledged in mindfulness research literature how meditation naïve participants respond differently to the Observing facet, such that Observing frequently shows negative correlations with other FFMQ facets (Siegling & Petrides, 2016, Baer et al., 2008; Bergomi et al. 2013; Rudkin et al., 2018). Though the methodology of the current study is supported by MAT, it is possible this approach to capturing mindful awareness through Observing was insufficient. For this reason, the
results of research question 3 should be only tentatively interpreted. Regardless, Observing remains commonly utilized in measuring trait mindfulness in non-meditator samples, or in assessing baseline mindfulness in pre-post studies of MBIs (Baer et al., 2006; Baer et al., 2012; Kaplan et al., 2018; Naliboff et al., 2020). Given the demonstrable concerns regarding validity of the FFMQ’s Observing facet, it may not be prudent for Observing to be used for testing MAT, especially in meditation-naive samples.

It is possible non-meditators also respond differently to acceptance-related FFMQ items, including items within the Nonjudging and Nonreactivity facets. As the popular press often overlooks acceptance, laypeople and informally trained practitioners may not view acceptance as a crucial aspect of mindfulness, creating difficulties in accurately measuring acceptance-based components of mindfulness in self-report trait mindfulness assessments (Choi et al., 2021). Consequently, measures of mindfulness emphasizing acceptance in meditation-naive respondents may produce results not aligning with current academic views of mindful acceptance. In this context, the results of the third research question of the current study, which showed a positive relationship between mindful acceptance and BP, seem understandable.

Furthermore, it is unclear if non-meditators understand the assumed interdependence between acceptance and awareness. According to Baer's (2019) psychometric studies on popular measures of trait-mindfulness, non-meditators show weak correlations between nonjudgment, Nonreactivity, and present-moment awareness. Consequently, a non-meditator respondent may incorrectly view acceptance and
awareness as separate concepts instead of interrelated elements of a unified practice, and answer differently as a result. The results of Choi et al. (2021)’s nomological analysis support this possibility, showing in the FFMQ specifically how non-meditator samples reported negative associations between Observing and Nonjudging, whereas trained meditators showed positive relationships between these facets.

Alternately, if the current study’s analysis does adequately match MAT’s interaction between mindful awareness and acceptance, with these constructs being adequately captured by the FFMQ facets utilized, this interaction genuinely may not relate to BP in meditation-naive samples. However, before lending credence to either of these interpretations, the methodology of calculating the interactive effects mindful awareness and acceptance used in the current study must be adequately replicated and validated. Altogether, these results highlight the need for greater consideration of measurement methodology and validation in mindfulness research, particularly in the case of the increasingly numerous theories describing how mindfulness may relate to health.

**Considerations Regarding Measurement Model Type**

One particularly critical consideration regarding measurement methodology in mindfulness research is if mindfulness is best measured with causal or reflective indicators. Most models (and resulting measures) within psychological science are conceptualized as models with reflective indicators, or reflective measurement models (Bollen & Diamantopoulos, 2015). In reflective measurement models, causality flows from the latent construct to the observed indicator(s), such that the indicators reflect the
underlying latent variable. Conceptually, if change in a latent variable is likely to cause change in the indicators, the indicators are implied to be reflective (Bollen & Lennox, 1991). Additionally, in reflective measurement models, the underlying latent concept exists even in the absence of the reflective indicators. As a result, the indicators are functionally interchangeable, and even if the indicators change, the shared variance between the indicators driven by the latent concept remains capturable (Bollen & Lennox, 1991). Mathematically in reflective models, indicators are expected to be correlated as interchangeability implies correlation, though the covariance between indicators is typically constrained to be zero when the latent variable is included in the model.

The opposite is also possible. In the case of causal (formative) measurement models, causality instead flows from the observed indicators to the latent construct, with the indicators ‘causing’ the latent construct (Coltman et al., 2008). Conceptually, if change in indicators of a latent concept seems likely to cause change in the latent concept, the indicators are implied to be causal (Bollen & Diamantopoulos, 2015). In contrast to reflective measurement models, indicators are not interchangeable in causal measurement models. This is because in causal models, each specific indicator should uniquely contribute to the latent concept. Therefore, if the indicators in a causal model are changed, the construct being examined fundamentally changes (Coltman et al., 2008). Finally, again in contrast to reflective measurement models, the covariance between indicators is not codified in causal measurement models as indicators are not expected to be interchangeable and may vary widely from one another (Bollen & Bauldry, 2011).
The determination of a construct having causal or reflective indicators is considered most strongly established based upon conceptual theory versus empirical findings (Bollen, 1989; Bollen, 2011). Treating a causal measurement model instead as reflective causes bias in the relationship between the indicators and the latent variable captured, which may also affect other portions of the model, depending on the specific model at hand. As structural models are inherently defined by their relationships, distinguishing if a conceptual model has causal or reflective indicators is an important step in model establishment, construct validation, and theory testing (Anderson & Gerbing, 1988, Coltman et al., 2008).

Most approaches to model measurement in the psychological sciences assume reflective measurement models, including item response theory, summed rating scale construction, Cronbach’s alpha, and exploratory factor analysis (Spector, 1992; Meade & Lautenschlager, 2004; Bollen & Lennox, 1991; Harman, 1976). Likewise, trait mindfulness measures use these approaches for testing and validation, implying they are generally considered reflective measurement models, like how equanimity was conceptualized in the first and second research questions of the current study (Baer et al., 2006, Neuser, 2010; Williams & Karl, 2014; Gu et al., 2016; Karl & Fischer, 2020). This would indicate causality flows from latent mindfulness, or mindfulness-like constructs like equanimity, to observed indicators reflecting mindfulness (reflective measurement model, e.g., conceptually equanimity underlies Nonjudging, Nonreactivity, Acting with Awareness, changes in equanimity should cause variation in values of said facets, but changes in said facets do not cause variation in equanimity).
Yet, as earlier described, the methodology used in the current study reflecting equanimity as a reflective measurement model appeared unsuccessful. One possible explanation is trait mindfulness, or mindfulness-like concepts such as equanimity, are best captured using causal indicators. At a broad conceptual level, trait mindfulness is often considered multidimensional, with the various facets of trait mindfulness differing substantially. These facets are described as being interrelated, but not necessarily positively correlated, and are not considered interchangeable insofar as contributing to the higher level ‘mindfulness’ construct (Baer et al., 2006). Each of these conceptual factors indicates trait mindfulness appears better aligned with causal measurement models than reflective models.

On a more empirical level, a key reason the current study was conceptualized and completed was the dearth of earlier-stage research investigating the basic correlational links of trait mindfulness and health. This logic also follows for trait mindfulness alone. Although multiple factor analyses of various measures of trait mindfulness have been published, factor analytic methodology inherently implies a reflective measurement model. Factor analyses cannot adequately test if variation in mindfulness facets would cause variation in the higher-order mindfulness construct—essentially, they cannot test if mindfulness has causal indicators (Bollen & Diamantopoulos, 2015). This possibility remains to be thoroughly examined.

If mindfulness is indeed best measured using causal indicators, there are several important implications to consider. First, mindfulness having causal indicators (facets) subsequently implies these facets are not interchangeable. The sheer variance in
conceptualizations of mindfulness and mindfulness-like constructs is in this context is concerning and emphasizes the need for a consensus operational definition of mindfulness. Other implications regarding this topic are discussed in greater detail later in the discussion section, under the heading ‘The State of Mindfulness Research, and Relations to the Current Study’.

Second, improperly identifying a causal measurement model as reflective may consequently affect interventions based upon said model. For instance, consider MBSR as an intervention for high BP, and suppose we are primarily examining how change in latent trait mindfulness impacts BP. Several possible causal indicators of change in mindfulness may be time spent engaging in mindfulness practices outside of the intervention, increased awareness and acceptance, as well as decreased rumination and suppression. Interventions which directly impact these indicators should directly effect change in mindfulness, and indirectly effect BP. Yet, if these indicators are instead treated as reflective, they would be considered as having no effect on BP. Essentially, determining the active components of an intervention relies on the appropriate specification of either reflective or causal indicators.

The State of Mindfulness Research, and Relations to the Current Study

The current study was intended as a theory-driven test of two current conceptualizations describing how trait mindfulness may relate with BP. It is possible the methodology of calculating equanimity and mindful awareness and acceptance using FFMQ facets drove the unexpected results found. Lindsay and Creswell appear to have similarly adapted the FFMQ to test portions of the MAT’s hypotheses, particularly using
items from nonjudging to assess the necessity of teaching acceptance in mindfulness training for beneficial cardiovascular outcomes (Chin et al., 2019). Results of the first study testing this hypothesis indicated participants who were randomized to a 14-lesson smartphone-based mindfulness intervention showed heightened nonjudgement following the intervention versus participants who were randomized to control groups. However, an unpublished follow-up dismantling trial failed to replicate the main results of this first study (Lindsay & Creswell, 2018).

These results, the concerns with FFMQ validity, and the uncertainty if trait mindfulness has reflective or causal indicators, likely contribute to several overarching issues in trait mindfulness research. These include but are not limited to the diversity of operational definitions of mindfulness, the over-saturation of self-report trait mindfulness scales reflecting different definitions, and the tendency for researchers to generalize findings using different definitions of mindfulness and measures of trait mindfulness into a singular ‘mindfulness’ construct.

As stated by Van Damn (2018) in his landmark critique identifying key weaknesses in the field of mindfulness research, the advancement of scientific learning and understanding is a complex and lengthy process, requiring plethoric effort, debate, and data. Yet, as mindfulness has proliferated within American society, mindfulness researchers have quickly shifted between supporting and disfavoring numerous different models of mindfulness, and theories of how mindfulness might impact health (Keng et al., 2011; Schuman-Olivier et al., 2020; Loucks et al., 2015; Lindsay & Creswell, 2017; Desbordes et al., 2015; Hadash et al., 2016; Juneau et al., 2020). Although this continual
shift is a necessary step of the scientific process, the publication rate of mindfulness research is explosive, as shown in Figure 10 (American Mindfulness Research Association, 2023). A recent review discussing the state of research on trait mindfulness found an average yearly growth rate of 31.64% for trait mindfulness-focused publications, indicating similar marked and rapid expansion over time (Karl & Fischer, 2022).

Figure 10

Mindfulness Journal Publications by Year, 1980-2022

Note. Data obtained from ISI Web of Science search of "mindfulness" in title of academic journal articles.
Notwithstanding, a consensus operational definition of mindfulness and a consensus method of measuring trait mindfulness remain absent (Van Dam et al., 2018). The FFMQ aimed to provide such a consensus yet has threats to validity debatably limiting functionality, particularly in meditation-naive samples (Van Dam et al., 2009; Goldberg et al., 2017; Goyal et al., 2014; Pelham III et al., 2019). Furthermore, though many trait mindfulness measures tend to have thematically matching subscales, studies of convergent validity among many of the most commonly used measures of trait mindfulness show poor to modest convergence (Baer et al., 2006, Park et al., 2013).

Despite this, putative findings of trait mindfulness and mindfulness intervention research using different operational definitions of mindfulness, different measures of trait mindfulness, and different MBIs, are often aggregated and discussed as effects of ‘mindfulness’ (Choi et al., 2021). As examples, Langerian mindfulness refers to a process of making novel distinctions, which differs substantially from the traditional Buddhist approach to mindfulness, which differs again from the relatively secular FFMQ. Concurrently, operationalizations of mindful acceptance involve a wide range of constructs, including but not limited to openness to experience (FMI), curiosity (TMS), decentering (TMS), Nonjudging and Nonreactivity (FFMQ), self-acceptance (KIMS), and arguably equanimity.

Mindfulness research studies are designed from a research base which historically uses mindfulness to refer to many different constructs, while simultaneously labeling highly similar mindfulness-ancillary constructs as disparate. Consideration must be given to these nuances in how past research has defined and measured mindfulness. Yet due to
the popularity of mindfulness in current American culture, these results are frequently published within the popular press. They are subsequently widely disseminated without adequate consideration paid to definitions of mindfulness and mindfulness measures used, resulting in issues of validity and generalizability of the findings, or the likely related demonstrably poor replicability of mindfulness studies (Chin et al., 2019; De Castro, 2019; Hsiao et al., 2018).

In tandem with the frequent over-interpretation of very tentative results by both academia and the popular press, the plethora of mixed results shown in cross-sectional studies testing the relationships between trait mindfulness and objective measures of cardiovascular health, and in experimental studies examining effects of MBIs on cardiovascular health, are conceivable. As discussed in the introduction of this document, the extant literature examining the links between clinic BP and baseline trait mindfulness as measured by the FFMQ is highly limited. Only one study to date has examined these associations (Tomfohr et al., 2015). Though results of this prior study supported MAT, the overall line of research is nascent and likely fundamentally influenced by the above noted concerns.

Apart from direct tests of clinic BP and trait mindfulness, several studies have examined the relationship between trait mindfulness and cardiovascular stress reactivity or recovery. These studies show mixed results. One study found trait mindfulness, measured by the Mindful Attention Awareness Scale (MAAS), negatively associated with SBP reactivity but had no associations with DBP reactivity (Kimmes et al., 2017). Another study of HR reactivity and recovery found participants with higher trait
mindfulness measured by the Kentucky Inventory of Mindfulness Skills (KIMS) showed better HR recovery from stress, but not lower HR reactivity during the stressor itself (Bullis, Bøe, Asnaani & Hofmann, 2014). Finally, another study demonstrated higher trait mindfulness again measured by the MAAS predicted decreased HR reactivity, but counter-intuitively also correlated with higher resting HR, and weakened HR recovery (Brzozowski, Gillespie, Dixton & Mitchell (2017). Thus, there have been several counterintuitive associations between higher trait mindfulness and cardiovascular parameters, like HR and BP, present in experimental laboratory research.

Experimental studies examining effects of MBIs on BP similarly show confusing results. One meta-analysis of 16 experimental studies in adults with CVD, which compared effects of MBIs to a control group, found MBIs generated improvements in SBP of medium to large effect size immediately post intervention, but not in DBP. Although both SBP and DBP impact cardiovascular health and disease risk, SBP is generally considered the stronger predictor of cardiovascular events and risk in adults (Mourad, 2008). Therefore, MBIs impacting SBP but not DBP may not be especially counter-intuitive in its clinical relevance. However, SBP and DBP levels are typically congruent, and it is unclear why SBP in isolation might be impacted by the MBI (Banegas et al., 2002). Effects on either SBP or DBP were not maintained at follow up, and the authors found significant heterogeneity across changes in BP elicited by the MBIs included within their meta-analysis. This finding of heterogeneity is consistent with results of an earlier, smaller meta-analysis of five RCTs which found a small improvement in BP for participants randomized to an MBI versus control, which became
null when the results of one study, which had the largest effects on BP, were removed from the analysis (Abbott, 2014).

Another recent meta-analysis of 12 RCTs in participants with at least stage 1 hypertension found MBIs generated clinic SBP and DBP decreases of 6.64 mmHg and 2.47 mmHg immediately post-intervention, respectively. These results were maintained 3-6 months post-intervention for DBP but not SBP (Lee et al., 2020). Several issues with study quality were identified by the authors of this meta-analysis, who found only one study to be of high quality. Issues in quality ranged from poor sequence generation, allocation concealment, and blinding, to providing incomplete outcome data and using nonstandard BP collection methods (Lee et al., 2020).

Moreover, numerous studies investigating the link between various MBIs and measures of cardiovascular health, particularly BP, have found null or even counter-intuitive effects. For example, Blom et al. (2014), in an RCT testing the effects of MBSR on ambulatory BP in adult participants with untreated stage one hypertensive BP found no change in ambulatory BP after MBSR training, or any significant differences in ambulatory BP between participants randomized to MBSR versus the waitlist control. Nijjar et al. (2019) reported in an RCT examining adult participants who had recently experienced a cardiac event, participants randomized to MBSR versus usual care showed no significant changes in BP, or significant differences from participants randomized to usual care, at either 3-months or 9-months post intervention.

A waitlist-controlled study of post-cancer treatment women found though MBSR group participants showed higher self-reported trait mindfulness (measured by the
MAAS), and decreased self-reported rumination as measured by the Rumination-Reflection Questionnaire, change in BP was no different than waitlist control participants (Campbell et al., 2012). Raja-Kahn et al. (2017), in an RCT testing effects of MBSR versus a health education control on trait mindfulness in healthy adults, found post-intervention increases in trait mindfulness (measured by the Toronto Mindfulness Scale) in MBSR-randomized participants, but no changes in BP. RCTs examining outcomes from non-MBSR MBIs in adults with obesity (Daubenmier et al., 2016), heart disease (Younge et al., 2015), adults working within a stressful environment (Hilcove et al., 2020), and stressed adults (Wolever et al., 2012), similarly show no impact of MBIs on BP, or no evidence of differences between participants randomized to the MBI versus control. When viewed together, both within individual studies examining multiple cardiovascular outcomes, and across different studies examining the same cardiovascular outcomes, results are often null or inconsistent.

In summary, the current study aimed to investigate the relationship between trait mindfulness and BP using two conceptualizations of mindfulness currently prominent in the research literature and found unexpected and null results. Apart from methodology limitations, issues germane to trait mindfulness research may have contributed to the unexpected findings of the present study. These issues include the lack of a consensus operational definition of mindfulness, resulting diversity in self-report methods of measuring trait mindfulness, and the tendency for findings using different operational definitions and methods of measuring trait mindfulness to be aggregated under the mindfulness umbrella. These issues plausibly promoted the plethoric mixed results present across cross-sectional studies examining the relationship of trait mindfulness and
cardiovascular health, and experimental studies examining the effects of mindfulness interventions on cardiovascular health. This likely contributes to the poor replicability of mindfulness research studies generally. Finally, though the scope of these problems eclipse the current study, the results may help inform improvements in trait mindfulness measurement.

Recommendations for Improving Trait Mindfulness Measurement

Identify a Consensus Operational Definition

First, a key issue impacting the validity of self-report measures of trait mindfulness is the recent poor consensus on an operational definition of mindfulness, and the numerous resultant ‘trait mindfulness’ measures. This issue is twofold- mindfulness is both a term applied in reference to disparate constructs, and many highly similar mindfulness-ancillary constructs are treated as disparate when they may in truth be similar or functionally identical. This use of myriad measurements poses the risk of correlating mindfulness with different outcomes depending on which scale or facet is utilized, as well as misattributing outcomes associated with one scale to another. A consensus operational definition of mindfulness may help to improve this field-wide issue.

Scientific consensus conferences may be a viable method for establishing a consensus operational definition of mindfulness, for determining if mindfulness-ancillary constructs are functionally distinct from said operational definition, and for determining if mindfulness should be measured in a causal or reflective measurement model. These
conferences involve a group of experts in the field coming together to discuss and debate the various definitions and conceptualizations of mindfulness, including different components of mindfulness. This method has been previously used, with the researchers included proposing attention and awareness as the two key factors involved in mindfulness (Bishop et al., 2004). Though this operational definition has been widely utilized and cited, it has not stopped the field-wide issues caused by different mindfulness concepts and methods of measuring trait mindfulness being aggregated under the mindfulness term. Holding decadal consensus conferences involving both expert mindfulness researchers and expert mindfulness practitioners may produce the operational definition of mindfulness which reflects field-wide changes in understanding over time and contribute towards more standardized and relevant measurement of mindfulness. In tandem, disseminating results in both peer-reviewed journals like *Mindfulness* for evaluation from the mindfulness research field and via popular-press outlets influencing practitioner’s perceptions of mindfulness, may provide better balance in how mindfulness is understood by researchers, practitioners, and laypeople.

**Methodology to Develop New Measures**

In a recent systematic review of commonly used measures of trait mindfulness, Park et al. (2013) found the development of these measures failed to involve input from target populations. In tandem with scientific consensus conferences fostering development of a consensus operational definition of mindfulness, holding non-meditator and experienced meditator focus groups may be of benefit. Focus groups can assist in ascertaining perspectives on how mindfulness is understood and utilized in daily life,
which may help guide development of more construct valid trait mindfulness measures. This approach could also provide an opportunity to explore potential differences in the understanding and application of mindfulness across diverse populations, which is crucial for ensuring culturally sensitive and applicable measures (Chin et al., 2019).

Additionally, while Park et al.’s systematic review found 66% of studies validating the measures were of good quality and 26% were of fair quality according to the COSMIN checklist, none of the measures included had sufficient evidence to support appropriate content validity or measurement error (2013). Validation of extant and novel measures using psychometrically sound methods and testing multiple forms of validity will improve measure quality and help ensure the measures used to assess mindfulness are valid, reliable, and appropriate for the target population.

**Considerations for New Self-Report Measures**

Mindfulness appears to be a multifaceted construct including various components, such as attentional control, present-moment awareness, and non-judgmental acceptance. Each of these components may be essential for a comprehensive understanding of mindfulness. Different facets of mindfulness may interact with each other in unique ways and may have diverse effects on various outcomes. Furthermore, individuals have strengths and weaknesses, and accordingly may have relative strengths in weaknesses across different aspects of mindfulness. Additionally, combining various facets of mindfulness into a single instrument may increase the risk of conflating mindfulness with related constructs, limiting the validity and specificity of the measure. Therefore, combining these facets into a single instrument is likely insufficient for capturing the
complexity of the construct. As argued in the introduction of this document, within the context of the status quo of trait mindfulness measurement, multidimensional measures of mindfulness are likely superior to unidimensional measures. Yet, issues are also present in multidimensional measures of trait mindfulness.

It is apparent the specificity of wording and syntax of items in self-report measures of trait mindfulness are highly important in capturing the constructs at hand, especially in meditation-naive samples. Commonly used self-report measures of trait mindfulness, like the FFMQ, FMI, and MAAS, use several negatively worded items. In the context of psychological research, negatively worded items are often poorly understood by respondents. This can cause error in item-to-total correlations and generate error in factor analyses (Idaszak & Drasgow, 1987; Colosi, 2005; Roszkowski & Soven, 2010). Moreover, negatively worded items in the FFMQ assess qualities like awareness of lapses in attention, or awareness of the tendency to criticize oneself. Such qualities arguably may be more difficult for meditation naive respondents to accurately track and report (May & Reinhardt, 2018). As a result, it is unclear if reversing the scores of items assessing dispositional tendency towards ‘mindless’ behavior is accurately assessing trait mindfulness. Positively worded items may provide a better measure of these mindful qualities (Burzler & Tran, 2022).

Furthermore, mindfulness, specifically mindful acceptance, likely fosters reflective and aware responses to situations. This is likely a process unfolding over time (Jijina & Biwas, 2022). Self-report measures of trait mindfulness have attempted to capture this using relatively short items with Likert-style responses (Baer et al., 2006;
Brown & Ryan, 2003; Walach et al., 2001). Yet, existing measures often do not take into account the context of the situation which one might be mindfully or mindlessly responding to. For non-meditating respondents, who are likely unfamiliar with the language of mindfulness, this may cause issues in valid responding. To provide a more comprehensive perspective on mindfulness measurement, it may be useful to ask longer questions surrounding how mindfulness may be applied in specific contexts. Instead of relying solely on brief items which largely lack context, researchers may benefit from considering incorporating somewhat longer items which give a situation context, particularly for non-meditating samples (Brienza et al., 2018; Grossmann et al., 2020; Vazire & Carlson, 2011).

Additionally, in studies using meditation-naive samples, it may be beneficial to require confirmation of respondent understanding of items in mindfulness scales (Park et al., 2013). As seen in the FFMQ in non-meditating respondents, it is possible for items to be misinterpreted, or for responses to occur in a manner inconsistent with the construct being measured. This leads to inaccurate data. Allowing researchers to ask participants about their understanding of items, as well as their interpretations and thought processes when answering, may help identify issues with item wording, comprehension, or interpretation. These issues can then be addressed to improve the accuracy and validity of the data collected (Park et al., 2013). If these possible solutions were to be applied, future measures of trait mindfulness may benefit from guidance written by authors of mindfulness measures on the appropriate use of said measures. Greater guidance may improve usage consistency and promote effective comparisons across studies.
Moreover, if these solutions were to be applied, measures capturing multiple facets of mindfulness (like the FFMQ) would likely require substantially more time. This may make multidimensional measures less practical in certain research or clinical contexts compared to simpler measures only focusing on a single aspect of mindfulness. A more nuanced method of measuring mindfulness may entail utilizing multiple shorter measures, each evaluating distinct elements of the construct, with researchers choosing specific measures depending on the hypotheses they wish to test. Developing and utilizing such individual instruments focusing on specific subdomains, and adopting titles accurately reflecting their contents, may improve construct validity in non-meditating respondents. Altogether, these possible changes may help reduce field-wide issues resulting from numerous instruments with vastly different content, all claiming to measure mindfulness.

Limitations of the Current Study

First, despite the FFMQ being commonly utilized to evaluate trait mindfulness, one key limitation of the current study is the use of FFMQ facets to calculate equanimity and mindful acceptance and awareness. Although the FFMQ is considered a gold-standard measurement of trait mindfulness, as earlier discussed, it has marked validity issues, especially in non-meditator samples. In the future, if more specific and in-depth measures of individual facets of trait mindfulness are published and validated, studies hoping to utilize similar methodology to the current study should consider the use of such measures. As the tendency of some trait mindfulness measures to include multiple facets of trait mindfulness in the same measure may confuse respondents (Park et al., 2013,
May & Reinhardt, 2018), choosing one or several unidimensional measures of distinct trait mindfulness facets representative of equanimity may be beneficial in the measurement of equanimity and other mindfulness-ancillary constructs. Using measures directly measuring self-report equanimity, like the EQUA-S, may also serve as a methodological improvement (Juneau et al., 2020).

Additionally, relevant variables such as diet and exercise were not controlled for, potentially impacting the accuracy of the models tested. Diet and exercise are well-known factors that can affect various aspects of health and well-being, which have been shown to relate to mindfulness. However, BMI was measured and included in the present analyses. As BMI typically captures both diet and exercise, the possible issues presented by these unmeasured variables is likely somewhat mitigated. Still, by not controlling for these variables, the current study may have unmeasured variables which could have influenced the observed relationships between equanimity, mindfulness as conceptualized in MAT, and BP.

Relatedly, another limitation is that the current study did not test health behaviors, like diet or exercise, as possible mediator variables. Previous studies have linked higher trait mindfulness with higher engagement in positive health behaviors (Loucks et al., 2016; Sala, Rochefort, Lui & Baldwin, 2019, Schuman-Olivier et al. 2020). Although the current results suggest stress, rumination, and suppression are not respectively moderators or mediators of the relationship between the conceptualizations of trait mindfulness tested and BP, future research should further investigate these relationships and consider other possible mediators, like health behaviors.
Finally, the sample consisted mainly of middle-age white individuals with higher socioeconomic status, which likely substantially limits the generalizability of the results. The issue of generalizability is a common concern in mindfulness research (Chin et al., 2019). Moreover, stress-related diseases are more common in people of color. For example, an estimated 43.5% of non-Hispanic Blacks, 33.0% of Hispanics, and 27.5% of non-Hispanic Whites fall within adult diagnosable criteria for HTN established by the 7th Report of the JNC on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (Fei et al., 2017). Black people experience the highest rates of CVD incidence and CVD morbidity compared with White and Hispanic people (Graham, 2015). Other demographics have similar disparities--older age is a primary risk factor for HTN and CVD (North & Sinclair, 2012), men have higher lifetime CVD risk and morbidity than women (Mosca et al., 2011), and people with lower SES have higher HTN and CVD incidence and morbidity compared against higher SES people (Schultz et al., 2018).

Given the demographic disparities in rates of CVDs, this limitation is especially important to consider when interpreting the results of the study, as the findings may not be generalizable to samples that are not majority middle age, White, and higher SES. Though the Serenity Study has a unique strength of having oversampled Black adults relative to proportion of the United States population at the time, White participants remained relatively oversampled (69.1%) compared to the general population (57.8%) (US Census Bureau, 2020). Furthermore, as people of color, and people who have lower SES, are often more stressed and are more highly impacted by CVD, the field of mindfulness research may benefit from exploring the links between mindfulness and
cardiovascular health in samples specifically representing these demographics, considerate of intersectionality (Chin et al., 2019).


### Appendix A

**Five Facet Mindfulness Questionnaire**

<table>
<thead>
<tr>
<th>Directions: Please rate each of the following statements using the scale provided. Fill in the option that best describes your own opinion of what is generally true for you.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When I'm walking, I deliberately notice the sensations of my body moving.</td>
</tr>
<tr>
<td>2. I'm good at finding words to describe my feelings.</td>
</tr>
<tr>
<td>3. I criticize myself for having irrational or inappropriate emotions.</td>
</tr>
<tr>
<td>4. I perceive my feelings and emotions without having to react to them.</td>
</tr>
<tr>
<td>5. When I do things, my mind wanders off and I'm easily distracted.</td>
</tr>
<tr>
<td>6. When I take a shower or bath, I stay alert to the sensations of water on my body.</td>
</tr>
<tr>
<td>7. I can easily put my beliefs, opinions, and expectations into words.</td>
</tr>
<tr>
<td>8. I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted.</td>
</tr>
<tr>
<td>9. I watch my feelings without getting lost in them.</td>
</tr>
<tr>
<td>10. I tell myself I shouldn't be feeling the way I'm feeling.</td>
</tr>
<tr>
<td>11. I notice how foods and drinks affect my thoughts, bodily sensations, and emotions.</td>
</tr>
<tr>
<td>12. It's hard for me to find the words to describe what I'm thinking.</td>
</tr>
<tr>
<td>13. I am easily distracted.</td>
</tr>
<tr>
<td>14. I believe some of my thoughts are abnormal or bad and I shouldn't think that way.</td>
</tr>
</tbody>
</table>


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.
<table>
<thead>
<tr>
<th></th>
<th>Never or very rarely true</th>
<th>Rarely true</th>
<th>Sometimes true</th>
<th>Often true</th>
<th>Very often or always true</th>
</tr>
</thead>
<tbody>
<tr>
<td>21. In difficult situations, I can pause without immediately reacting.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>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.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>23. It seems I am “running on automatic” without much awareness of what I’m doing.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>24. When I have distressing thoughts or images, I feel calm soon after.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>25. I tell myself that I shouldn’t be thinking the way I’m thinking.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>26. I notice the smells and aromas of things.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>27. Even when I’m feeling terribly upset, I can find a way to put it into words.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>28. I rush through activities without being really attentive to them.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>29. When I have distressing thoughts or images I am able just to notice them without reacting.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>30. I think some of my emotions are bad or inappropriate and I shouldn’t feel them.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>31. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>32. My natural tendency is to put my experiences into words.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>33. When I have distressing thoughts or images, I just notice them and let them go.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>34. I do jobs or tasks automatically without being aware of what I’m doing.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
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 B

Perceived Stress Scale

The following questions ask you about your feelings and thoughts during the last month. In each case, you are asked to indicate how often you felt or thought a certain way.

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Fairly Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In the last month, how often have you been upset because of something that happened unexpectedly?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2. In the last month, how often have you felt unable to control the important things in your life?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>3. In the last month, how often have you felt nervous and stressed?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>4. In the last month, how often have you felt confident about your ability to handle your personal problems?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>5. In the last month, how often have you felt that things were going your way?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>6. In the last month, how often have you found that you could not cope with all the things that you had to do?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>7. In the last month, how often have you been able to control irritations in your life?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>8. In the last month, how often have you felt that you were on top of things?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>9. In the last month, how often have you been angered because of things that were outside of your control?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Appendix C

Response Styles Questionnaire

People think and do many different things when they feel depressed. Please read each of the items below and indicate whether you almost never, sometimes, often, or almost always think or do each one when you feel down, sad, or depressed. Please indicate what you generally do, not what you think you should do.

1 almost never 2 sometimes 3 often 4 almost always

1. think about how alone you feel
2. think “I won’t be able to do my job if I don’t snap out of this”
3. think about your feelings of fatigue and achiness
4. think about how hard it is to concentrate
5. think “What am I doing to deserve this?”
6. think about how passive and unmotivated you feel.
7. analyze recent events to try to understand why you are depressed
8. think about how you don’t seem to feel anything anymore
9. think “Why can’t I get going?”
10. think “Why do I always react this way?”
11. go away by yourself and think about why you feel this way
12. write down what you are thinking about and analyze it
13. think about a recent situation, wishing it had gone better
14. think “I won’t be able to concentrate if I keep feeling this way.”
15. think “Why do I have problems other people don’t have?”
16. think “Why can’t I handle things better?”
17. think about how sad you feel.
18. think about all your shortcomings, failings, faults, mistakes
19. think about how you don’t feel up to doing anything
20. analyze your personality to try to understand why you are depressed
21. go someplace alone to think about your feelings
22. think about how angry you are with yourself
Appendix D

Emotion Regulation Questionnaire

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

| 1. strongly disagree | 2 | 3 | neutral | 4 | 5 | 6 | 7. strongly agree |

1. ____ When I want to feel more positive emotion (such as joy or amusement), I change what I’m thinking about.
2. ____ I keep my emotions to myself.
3. ____ When I want to feel less negative emotion (such as sadness or anger), I change what I’m thinking about.
4. ____ When I am feeling positive emotions, I am careful not to express them.
5. ____ When I’m faced with a stressful situation, I make myself think about it in a way that helps me stay calm.
6. ____ I control my emotions by not expressing them.
7. ____ When I want to feel more positive emotion, I change the way I’m thinking about the situation.
8. ____ I control my emotions by changing the way I think about the situation I’m in.
9. ____ When I am feeling negative emotions, I make sure not to express them.
10. ____ When I want to feel less negative emotion, I change the way I’m thinking about the situation.
Appendix E

CFA Code

TITLE: Equanimity CFA subscales

DATA: FILE IS "C:\Users\ching\Documents\DISSERTATION\Dissertation_Dataset_CFA.txt";

VARIABLE: NAMES ARE awa nj nr;

MODEL: equanimity BY awa nj nr;

OUTPUT: STANDARDIZED;
Appendix F

Research Question 1 Code

TITLE: Aim1;
DATA: FILE IS
   "C:\Users\ching\Documents\DISSEETATION\aim12datasettake2list.dat";
   TYPE IS imputation;
VARIABLE: NAMES ARE OBS DES AWA NJ NR STRESS SBP DBP AGE
   GENDER SES BMI FH RUM SUP;
USEVARIABLES ARE AWA NJ NR STRESS SBP AGE GENDER SES BMI FH;
   missing are .;

ANALYSIS: TYPE=Random;
ALGORITHM=INTEGRATION;
DEFINE: CENTER NR NJ AWA STRESS AGE SES BMI(GRAND);
MODEL:

EQUA BY AWA NJ NR; !equanimity latent variable!
STRESSxEQUA | STRESS XWITH EQUA;
!Structural model
SBP ON EQUA (b1); !IV
SBP ON STRESS (b2); !Moderator
SBP ON STRESSxEQUA (b3); !INTERACTION!
SBP ON AGE GENDER SES BMI FH;!CONFOUNDERS (AGE SES)
EQUA ON AGE SES; !CONFOUNDERS PLUS COVARS!
MODEL CONSTRAINT:

NEW(LOW_STRESS MED_STRESS HIGH_STRESS SIMP_LO SIMP_MED SIMP_HI);

LOW_STRESS = -1; ! -1 SD below mean of the Moderator
MED_STRESS = 0; ! mean of W
HIGH_STRESS = 1; ! +1 SD below mean of the Moderator

! Now calc simple slopes for each value of the Moderator

SIMP_LO = b1 + b3*LOW_STRESS;
SIMP_MED = b1 + b3*MED_STRESS;
SIMP_HI = b1 + b3*HIGH_STRESS;

! Use loop plot to plot total effects of X on Y for low, med, high values of the Moderator

! NOTE - values from -1 to 1 in LOOP() statement since X is factor with mean set at default of 0

PLOT(LOWSTRESS MEDSTRESS HIGHSTRESS);
LOOP(XVAL,-1,0,1);
LOWSTRESS = (b1 + b3*LOW_STRESS)*XVAL;
MEDSTRESS = (b1 + b3*MED_STRESS)*XVAL;
HIGHSTRESS = (b1 + b3*HIGH_STRESS)*XVAL;
PLOT: TYPE IS PLOT2;
OUTPUT: STAND CINT;
Appendix G

Research Question 2 Code

TITLE: Aim2;

DATA: FILE IS
"C:\Users\ching\Documents\DISSEITATION\aim12datassetake2list.dat";

TYPE IS imputation;

VARIABLE: NAMES ARE OBS DES AWA NJ NR STRESS SBP DBP AGE GENDER SES BMI FH RUM SUP;

USEVARIABLES ARE AWA NJ NR STRESS SBP AGE GENDER SES BMI FH RUM;

missing are .;

ANALYSIS: TYPE = RANDOM;

ALGORITHM=INTEGRATION;

DEFINE: CENTER NR NJ AWA STRESS AGE BMI SES RUM (GRAND);

MODEL:

EQUA BY AWA NJ NR; !equanimity latent variable!

!MODERATION MODEL!

STRESSxEQUA | STRESS XWITH EQUA;

!Structural model

SBP ON EQUA; !IV
SBP ON STRESS; !Moderator
SBP ON STRESSxEQUA; !INTERACTION!
SBP ON AGE GENDER SES BMI FH; !CONFOUNDERS COVARS!
EQUA ON AGE SES; !CONFOUNDERS!

!MEDIATION MODEL!
SBP ON RUM (b1);
SBP ON EQUA (cdash); ! direct effect of X on Y
RUM ON EQUA (a1);
! Use model constraint to calculate indirect paths
MODEL CONSTRAINT:
NEW(a1b1 TOTAL);
a1b1 = a1*b1; ! Specific indirect effect of X on Y via RRS conte
TOTAL = a1*b1 + cdash; ! Total effect of X on Y

OUTPUT: STAND CINT;
Appendix H

MCMC Syntax

TITLE: Aim1;

DATA: FILE IS

"C:\Users\ching\Documents\DISSEPTION\BIGDATASETFORALLAIMS_missingness.txt";

FORMAT IS free;

TYPE IS individual;

LISTWISE = OFF;

VARIABLE: NAMES ARE ID OBS DES AWA NJ NR STRESS SBP DBP AGE GENDER SES BMI FH RUM SUP SITE LA ZIP;

USEVARIABLES ARE OBS DES AWA NJ NR STRESS SBP DBP AGE GENDER SES BMI FH RUM SUP;

missing are .;

ANALYSIS:

!saturated imputation model;

TYPE = Basic;

!random number seed for mcmc algorithm;

bseed = 71790;

!convergence criterion (default = .05);

bconvergence = .05;

DATA IMPUTATION:
!variables to be imputed;
impute = OBS DES AWA NJ NR STRESS AGE
GENDER SES BMI FH RUM SUP;

!number of imputed datasets;
ndatasets = 50;

!file name prefix for datasets;
save=aim12datassetake2*.dat;

!between-imputation interval;
thin = 300;