ASSESSING MINDFULNESS AS A MODERATOR BETWEEN TRAIT WORRY AND WORKING MEMORY CAPACITY PERFORMANCE IN UNDERGRADUATES

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ABSTRACT

Mindfulness and worry have some antithetical qualities, yet mixed or non-significant findings suggest that practicing mindfulness alone will not disrupt worry. Working memory capacity (WMC) has been implicated in the relationship between worry and mindfulness, with some research showing that the combined practice of mindfulness and WMC test exercises had the greatest impact on reducing worry. The present study sought to test the relationship between worry, trait mindfulness, behavioral mindfulness as assessed by a Mindfulness Activities Questionnaire (MAQ) created by the researcher, and both the verbal and visuospatial domains of WMC. Worry was shown to be negatively associated with mindfulness. All WM scores showed non-significant associations apart from a weak positive association between verbal WM efficiency and behavioral mindfulness. Both domains of WM predicted similar outcomes in mindfulness. Mindfulness was not shown to moderate the relationship between worry and WMC. Implications and future directions for research are discussed.

DEDICATION

To my parents John and Laurie Farmer, whose support during this time and throughout my life will always be remembered.

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LIST OF ABBREVIATIONS

WM, working memory

WMC, working memory capacity

OSpan, operation span

SSpan, symmetry span

FFMQ, Five Facets of Mindfulness Questionnaire

PSWQ, Penn State Worry Questionnaire

MAAS, Mindfulness Attention Awareness Scale

MBI, Mindfulness Based Intervention

MAQ, Mindfulness Activities Questionnaire

AMPS, Applied Mindfulness Processes Scale

MWQ, Mind Wandering Questionnaire

CHAPTER I

INTRODUCTION

Worry is a state of apprehensive and intrusive negative thoughts about the future with concurrent mental distress or agitation about an impending event, threat or danger (Borkovec et al., 1983). Worry is a type of thinking style characterized by repeated, future-oriented negative thoughts and is expressed through verbal thought activity (Borkovec et al.,1998; Papageorgiou and Wells, 1999). Worry is also considered a cognitive behavior to prepare for the future; if excessive, worry may function as an avoidance response in the face of threatening stimuli (Borkovec et al., 1998; Kelly & Miller 1999; Ottaviani et al., 2014). Other lines of research suggest that worry may function as a means to draw cognitive resources toward noticing and evaluating safety cues (Cupid et al., 2021).

While a degree of worry is adaptive, excessive worry is a hallmark symptom of generalized anxiety disorder (Andrews & Borkovec, 1988; Cupid et al., 2021; Heller et al.,1998;). Among those with generalized anxiety disorder, greater worry is associated with increased disorder severity, comorbidity, and other negative outcomes (Hallion & Ruscio, 2013; Newman et al., 2013; Thielsch et al., 2015). Newman and Llera (2011) developed the *contrast avoidance model* which suggests that, in the case of generalized anxiety disorder specifically, worry does not suppress negative emotionality, but rather maintains it through a state of distress in preparation for future negative outcomes. This contrast model emphasizes that worry leads to greater negative emotionality, greater physiological activation associated with anxiety, and the

extended duration of these states. Worry is not limited to generalized anxiety disorder, however, as it is proposed to play a role in numerous affective disorders and has even been proposed as a transdiagnostic construct (McEvoy et al., 2013). For example, among undergraduate students, higher worry is associated with greater anxiety, lower GPA and retention rates, as well as poorer mental health overall (Eisenberg et al., 2009); however, some research with a sample of law school students found worry to be associated with better test performance and a higher class rank. These positive academic outcomes related to worry were found to be inversely related to trait anxiety, such that worry was only related to improved performance when trait anxiety was low (Siddique et al., 2006). The authors suggest that these results reflect deliberative versus facilitative functions of worry wherein the outcome of worry for those low in trait anxiety was found to be largely facilitative.

Worry and anxiety represent different yet related constructs. While worry is a cognitive behavioral correlate of anxiety, there appear to be different observations as to how these constructs impact performance. Siddique et al. (2006) proposed that the relationship between worry and academic performance changes when certain cognitively relevant variables are held constant (i.e. trait anxiety). It was also proposed that the positive academic outcomes associated with worry arose from its facilitative function (worrying in a way that is problem-solving oriented). In order to gain a more thorough mechanistic understanding of the impact of worry on student performance, it may be worthwhile to investigate how worry may interrupt cognitive processes that are considered facilitative for success in the academic environment.

Theories Addressing the Relationship between Worry and Working Memory Capacity

Working memory (WM) is an aspect of short-term memory that simultaneously holds and adapts knowledge to obtain a current goal or engagement. *Working memory capacity* (WMC) represents the storage component of the working memory system, and is important for reasoning, comprehension, and learning (Baddeley, 2010)—all components that are critical for college student success. Working memory is hypothesized to consist of a *phonological loop* that is responsible for the brief storage and manipulation of verbal information. Working memory also consists of a theoretical *visuospatial sketchpad* that is responsible for manipulating visual images and a *central executive* that performs attentional tasks and coordinates other subsystems (Baddeley, 2010; Baddeley & Della-Sala, 1996; Baddeley & Hitch 1974; Chai et al., 2018; Repovs & Bresjanak, 2006). Eysenck's *attentional control theory* posits that anxiety produces worry and other intrusive thoughts that compete for resources in working memory—leading to impaired memory performance (Eysenck et al., 2007). The theory predicts that anxiety should interfere with verbal (i.e., phonological) tasks and with tasks requiring complex attention and coordination but should not interfere with simple visuospatial tasks, as the demands on the central executive are relatively low. The relation between anxiety (both worry and arousal) and WMC may involve interference or competition with task-relevant resources, similar to the relationship between stress and WMC (Moran, 2016). Some researchers claim that anxiety causes deficits in cognition by competing with attention, phonological resources, or storage of memory representations suggesting that capacity within the working memory system plays an important role in cognitive performance, particularly in the face of interference of high task demand (e.g., Cocks et al., 2016; Eysenck & Calvo, 1992; Eysenck & Derakshan, 2011; Eysenck, et al., 2007; Robinson et al., 2013; Shackman et al., 2006). Others propose that pre-

existing cognitive deficits predispose individuals to anxiety, suggesting a possible bidirectional relationship between WMC and anxiety (e.g., Mathews & MacLeod, 2005; Ouimet et al., 2009).

Evaluating Relationships among Specific Domains of Anxiety and WMC

Working memory capacity can be conceptualized from both domain-specific as well as domain-general perspectives. The *domain-specific perspective* suggests that the verbal and visuospatial mechanisms of WMC are related yet distinct. *The domain-general perspective* suggests that the processes used in any complex span task for assessing working memory are the same. In a recent meta-analysis, Moran (2016) found a moderate but robust negative association between a variety of self-report measures of anxiety (both worry and arousal) and measures of WMC. The authors concluded that both domains of anxiety (worry and arousal) were associated with deficits in both domains of WMC (verbal and visuospatial). The author even goes on to suggest that anxiety likely influences WMC through its negative relationship with what has been termed *fluid cognition* (processing and integration of information to act, and solve problems [Horn & Cattell, 1967]) in addition to its impact on other variables related to WMC (i.e. attention, and reasoning). In a study included in this meta-analysis, Shackman et al. (2006) found particular domains of anxiety to influence particular domains of WMC; specifically, individuals high in measures of physiological anxiety were found to perform more poorly on tests targeting spatial processes, whereas individuals high in measures of worry were found to perform more poorly on tests targeting phonological processes. While Shackman's findings seem to suggest unique relationships between domains of anxiety and domains of WMC (i.e., physiological and spatial WM, versus worry and phonological WM), the larger body of research which Moran reviewed seems to suggest that both worry and arousal influence both spatial and phonological

processes—thus supporting the domain general perspective as a more reliably observed outcome. Regardless of domain specificity, the meta-analysis revealed a moderate and robust relationship between anxiety and reduced WMC (g = -.33). This means, by extension of the fact that worry is a domain of anxiety, worry has a negative association with, and likely influence on, WMC. Given a history of mixed findings on domain specificity for anxiety/worry and WMC, Shackman's findings suggest a need to continue measuring domains of anxiety against domains of WMC by including a variety of worry measures and complex span tasks.

Further Exploring the Relationship between Worry and Working Memory Capacity among College Students

One reason that college students are a compelling group to study in relation to worry and WMC is because of the major life transitions and new responsibilities associated with college and emerging adulthood. Ross et al. (1999) found in a sample of undergraduates that changes in sleep and eating habits, as well as new increased workload/responsibility, were among the top contributors to general and intrapersonal stress reported by students. Wright (1967) emphasized that stress, which is not dealt with adequately, may contribute to feelings of loneliness, nervousness, sleeplessness, and worry. Thus, students with high trait anxiety (who worry often) may find it difficult to fully engage cognitive capacity and perform well academically and experience greater overall distress and life impairment.

Johnson and Gronlund (2009) found in an undergraduate student sample that trait anxiety measured by the *State-Trait Anxiety Inventory* (STAI; Spielberger, 1977) was negatively associated with WMC performance measured by the complex Operation Span task, which was designed to assess WMC (Turner & Engle, 1989). However, higher WMC performance

attenuated the negative relation between anxiety and a more cognitively demanding version of the Operation Span task. This suggests that high anxiety may interfere with WMC and that greater WMC may help mitigate the influence anxiety has on cognition. While anxiety is a related but separate construct from worry, this data also showed early promise for implications of worry on WMC in a college sample.

Sari et al. (2017) investigated the influence that active worrying has on WMC in a student sample. They split participants into an "active worry" or control group condition and found that level of self-reported trait worry (via the *Penn State Worry Questionnaire*) mediated the relationship between condition and changes in WMC. Specifically, the effect of the worry exposure condition on WMC was no longer significant after adding initial self-reported trait worry to the model.

In summary, among undergraduate samples, there is reliable evidence that higher WMC may be a protective factor in the relation between anxiety and memory task performance; however, worry may compromise the protective factor of WMC, directly or indirectly, on memory performance. Additional evidence, as reviewed above, highlights that the worry-WMC relation maintains bidirectional influence. Thus, WMC appears to be an avenue for mitigating the influence of worry on memory performance. In addition, targeting worry directly, which is most oftentimes done in interventions (e.g., Johnson & Gronlund, 2009) and experimental manipulations (e.g., Sari et al., 2017), may reduce the negative effects of worry on WMC and improve subsequent memory performance. Given that worry is a cognitive behavior, it may be possible to moderate its impact on WMC, and vice versa, by employing practical antithetical cognitive strategies aimed to reduce future-oriented worry (i.e., present-centeredness), reduce

physiological arousal associated with co-occurring anxiety (e.g., relaxation strategies), and to enhance WMC.

Practical and Accessible Solutions: Mindfulness and Worry

Mindfulness has been popularly described as paying attention in a particular way: on purpose, in the present moment, and doing so non-judgmentally (Kabat-Zinn, 2005). This description elicits three "axioms" from which composite qualities of mindfulness emerge, including (1) intention, (2) attention, and (3) attitude (Shapiro et al., 2006, pg. 375). *Intention* refers to the need for a "personal vision", suggesting that the benefits of mindful practice are limited by what one seeks to gain from such practice. *Attention* refers to observing internal and external experiences while "suspending ways of interpreting" said experiences (i.e., without judgement). *Attitude* refers to the quality of attention paid, with mindful attention being described as "compassionate, open-hearted, and non-judgmental" (Shapiro et al., 2006, pg. 375-377). It is suggested that the axioms have bidirectional relationships and can be used to cultivate growth in each other. The formal practice of mindfulness traditionally occurs through meditation, which has been described as the process of building scaffolding for greater mindfulness (Kabat-Zinn, 2005). In the following sections, I will provide a brief scientific literature review of how mindfulness is conceptualized and how it relates to worry. I will distinguish between relevant types of mindfulness and different ways that they are assessed. Broadly, these methods of assessment have included participant self-report of mindfulness traits, therapeutic interventions, and mindfulness inductions.

Trait Mindfulness

Regular meditation can be used to increase a more enduring form of mindfulness referred to as *trait mindfulness* (Kiken et al., 2015). Mindfulness can be divided into state and trait capacities, whereby state mindfulness refers to the real-time practice of meditative action, and trait mindfulness refers to an enduring dispositional quality present in daily life (Baer et al., 2006; Lau et al., 2006).

Worry is high in repetitive negatively valanced thinking and is focused on problem solving (Evans & Segerstrom, 2011); although, excessive worry may counterintuitively impair problem solving (Llera & Newman 2020). Chambers et al. (2008) found mindfulness to be negatively associated with the presence of repetitive negative thoughts, including worry, suggesting that more mindful individuals worry less. Arch and Craske (2006) and Banerjee et al. (2018) have identified characteristics of worry and mindfulness that may clarify the relationship between worry and mindfulness. They describe chronic worry as being characterized by anticipation, cognitive avoidance (i.e., trying not to think about anxiety-provoking content), and non-acceptance of uncertainty. These maladaptive cognitive-affective states directly contrast with the attention and attitude axioms of mindfulness, which emphasize regulation of attention toward the present moment and the maintenance of a non-judgmental attitude-- collectively allowing for restructuring of maladaptive thoughts (Carmody, 2009). This theoretical link between worry and mindfulness has prompted research on and practice of incorporating Buddhist meditation techniques into psychological treatment for generalized anxiety disorder (to be discussed below), which is characterized by chronic worry (Evans & Segerstrom, 2011).

Evans and Segerstrom, (2011) investigated the theoretical link posed by Arch and Craske (2006) using an undergraduate student sample. Participants were asked to complete the *Five*

Facets of Mindfulness Questionnaire (FFMQ; Baer et al., 2006) and a series of repetitive thought measures. They found that mindfulness correlated with less repetitive thinking and more positively valanced thoughts. After assessing subscales of the FFMQ, they found that the *non-judging*, and *acting with awareness* subscales were associated with a decrease in total repetitive thinking, while the aforementioned subscales, as well as the *describing* subscale, were associated with positive repetitive thought. The authors suggest that the *non-judging* subscale of mindfulness acts as a filter for repetitive thought. These findings suggest that *non-judging* is a critical part of mindfulness, and characteristically differs from the non-acceptance of uncertainty component within worry. Furthermore, the *acting with awareness* subscale was also associated with positive and decreased repetitive thought, and characteristically differs from the cognitive avoidance component of worry.

Fisak and Lehe (2012) utilized a similar methodology wherein a student sample was studied in order to gain a better theoretical understanding of the relationship between mindfulness and symptoms of generalized anxiety disorder. After looking at responses to the FFMQ and the *Penn State Worry Questionnaire* (PSWQ), they found that the *non-reactivity*, *non-judging*, and *acting with awareness* subscales of the FFMQ were negatively associated with worry. While the Evans and Segerstrom article focused more on repetitive thinking in general, both of these articles point to the same subscales of the FFMQ to identify unique aspects shared between mindfulness and worry: traits of *non-judging* and *acting with awareness*.

Approaching mindfulness and worry from a different perspective, Martin et al. (2017) investigated the relationship between early maladaptive schemas (self-defeating beliefs and thinking styles) and depressive-related symptoms (including worry) as moderated by trait mindfulness. Higher trait mindfulness assessed by the *Mindfulness Attention Awareness Scale*

(MAAS: Brown & Ryan, 2003) was found to moderate the relationship between maladaptive schemas assessed by the *Young Schema Questionnaire* (Young & Brown, 2005) and depressive symptoms. The authors posited that higher trait mindfulness is associated with greater present-moment awareness, which allows for reductions in cognitive coping responses associated with long-held maladaptive schemas. Similarly, they also suggested that the adoption of early maladaptive schemas hinders the development of trait mindfulness—leading to the development of non-mindful skills in emotion regulation and increases the likelihood for developing depression. Positive correlations are consistently found between depression and worry (Buck et al., 2008; Segerstrom et al., 2000; Starcevic, 1995), and worry has been postulated to be a common component of major depression (Starcevic, 1995). Thus, while depression was directly assessed in the Martin et al. study, future replications focusing on worry domains may be fruitful.

Per self-report data outcomes in the literature, trait mindfulness may be associated with worry via non-reactivity and non-judgmental awareness in response to internal and external experiences. Studies reviewed here addressed worry's relationship with trait mindfulness from different perspectives; as a component of repetitive thought (Evans & Segerstrom, 2011), as a component of depression (Martin et al., 2017), and as an independent construct (Fisak & Lehe, 2012). Mindfulness was also assessed using two common measures of trait mindfulness (FFMQ, and the *Mindfulness Attention Awareness Scale* (MAAS)). Mindful individuals have more positive and f repetitive thought patterns. Mindful individuals appear less judgmental (especially toward themselves) and are keen to act without analysis paralysis. This research illustrates certain qualities of mindfulness to compete with worry; namely non-judging and acting with awareness. While self-report studies have highlighted trends among individuals' experiences,

additional research has employed mindfulness practice protocols to further understand shared mechanisms between worry and mindfulness.

Mindfulness Interventions

In a review of empirical trials for *mindfulness-based interventions* (MBIs) for worry and rumination, Gaynor (2014) reviewed four different types of interventions that showed significant outcomes in reducing worry. Specifically, *mindfulness based cognitive therapy* has been shown to reduce depression and worry symptoms for both non-clinical (Batink et al., 2013) and clinical (Van Aalderen et al., 2012) adult populations, and in both studies, mechanisms of mindfulness induction and worry reduction were identified as potential mechanisms of therapeutic action. Also in Gaynor's review, an eight-week *mindfulness based stress reduction* protocol was associated with increases in trait mindfulness and emotion regulation (non-clinical sample; Robins et al., 2012) and generalized anxiety disorder symptom reduction (clinical sample; Vollestad et al., 2011), using randomized-controlled approaches. Of note, in the latter trial, the experimental condition showed greatest improvement for depression and anxiety symptoms, with weak changes in worry and trait anxiety symptoms, compared to the waitlist control condition. Upon further investigation, mindfulness partially mediated the relationship between intervention assignment, and both worry and trait anxiety. Gaynor's review suggests that both mindfulness based cognitive therapy and mindfulness based stress reduction are effective for reducing worry and other clinical symptoms while increasing mindfulness, thereby highlighting via experimental manipulation that worry may be impacted by targeting facets of mindfulness.

In a more recent meta-analytic review, Dawson et al. (2020) investigated the influence of MBIs in 51 randomized control trials in university student samples. Results indicated that when

compared to passive controls, MBIs were shown to improve distress, anxiety, depression, well-being, rumination, and mindfulness following intervention completion. Additionally, effects for stress and mindfulness were found to last beyond three months. When compared to active controls, MBIs were found to reduce distress and state anxiety; a significant effect on worry was not found in any condition. Moderator analyses revealed no difference based on intervention duration, delivery mode, or sub-population. The authors suggested that MBIs may be promising for helping students with their mental health, specifically via reduction in psychological distress. This is likely related to the way that mindfulness cultivates non-judgmental awareness of inner experiences. One curious thing to note is that while reduction in psychological distress was found, there were some variables which are typically associated with MBIs (i.e. worry) that did not show the same significant reductions. This seems to suggest that these variables, most explicitly worry, are related to other prominent cognitive variables that are not adequately engaged by MBIs alone, in order to see substantial and consistent reductions. These findings among others, contribute to this call for more thorough research into the therapeutic potential of MBIs.

In a female student population with high scores on the PSWQ, Delgado-Pastor et al. (2015) investigated the effectiveness of *mindfulness cognitive training* (i.e., guided meditation through one's current mental state) and *mindfulness interoceptive training* (i.e., on internal bodily sensations) on reducing worry and physiological expressions of arousal. Both interventions were found to significantly reduce worry, while the interoceptive training was found to be particularly effective in reducing anxious physiological arousal. Thus, some mindfulness intervention approaches may be effective when they share more theoretical and mechanistic underpinnings with specific dimensions of anxiety (i.e., worry versus arousal).

It seems that the relationship between MBIs and mental health outcomes (mainly worry/anxiety) is still unclear, with some research showing improvement as a result of mindfulness intervention (Gaynor, 2014; Delgado-Pastor et al., 2015) and others drawing insignificant or mixed findings (Dawson et al., 2020). While it seems unlikely that duration and mode of intervention would have a negligible influence, Dawson and colleagues acknowledge the need to rigorously follow through on their findings. This acknowledgement can be taken with the findings from Gaynor and Delgado-Pastor et al, to illustrate that future research with MBIs should continue to investigate the merits of specific forms of MBI on worry. Additionally, future work should investigate how MBIs (or mindfulness in general) may interact with relevant cognitive variables (i.e. attention and working memory) to mechanistically target worry.

To better understand how working memory might relate to the relationship between MBIs and worry, Course-Choi et al. (2017) asked a non-clinical sample of high worriers to complete a week-long intervention. In this intervention, researchers split participants into *mindfulness meditation practice*, *dual adaptive n-back*, or combined conditions, with the goal of determining whether mindfulness meditation practice, the *n*-back exercise, or both combined had a significant effect on worry. The results indicated that using working memory exercises (*n*-back) in conjunction with mindfulness meditation practice showed the greatest worry reduction in the week following the training. Furthermore, participants in the *n*-back only condition experienced improvements on measures of attentional control and resilience in addition to worry. While MBIs have shown promise to improve aspects of mental health (i.e. anxiety and stress), its effect on worry has not been consistently observed. This may result from different types of MBIs used under different circumstances, or the presence of other distinct cognitive variables at work. Perhaps the therapeutic potential of MBIs (or mindfulness in general) for worry, is connected to

mechanisms in working memory. While mindfulness and worry appear to be antithetical in several ways, learning mindfulness techniques may not be enough to substantially disrupt worry. It may be that learning mindfulness techniques while practicing cognitive exercises engaging with working memory is the means to substantially disrupt worry.

Brief Mindfulness Induction Paradigms and Worry

Another method for assessing worry involves a state (i.e., *in vivo*) induction. One popular induction method originated from a theoretical model proposed by Bishop et al. (2004), wherein a state of mindfulness is said to involve two components: *self-regulation of attention* and *orientation toward experience*. Bishop and associates express that these components are easier to achieve with practice, suggesting that novices require more thorough inductions. From this operationalization, 15-minute audio clips have become a standard in research seeking to provide a brief mindfulness induction (e.g., Arch & Craske, 2006; Verplanken & Fisher, 2014).

In a study by Verplanken and Fisher (2014b), participants were split into either a 15-minute mindfulness breathing meditation (experimental) or neutral audio (control) conditions. Next, they were assessed on affect using the *Positive and Negative Affect Scale* and habitual worry using the *Habit Index of Negative Thinking* (Verplanken & Orbell, 2003). This was followed by a picture viewing task. Afterwards, the two conditions were compared on how they rated the pictures and how many pictures they chose to observe, with these two outcomes used as indicators for tolerance of distress. Results indicated that high worry individuals in the experimental group chose to view more images and tended to rate them as less disturbing when compared to their high worry control counterparts. More recent research using a similar experimental paradigm has replicated these findings (Carpenter et al., 2019; Schumer & Lindsay,

2018). Collectively, these findings suggest a causal relationship between mindfulness experience and tolerance of distress.

The recurrence and avoidance of negative thoughts and emotions that characterize worry creates a state of distress for the worrier. Those with high worry may seek to avoid distress by engaging in repetitive cognitive loops to alleviate fear and uncertainty, only to have the state of distress persist as the underlying concerns are not addressed (Borkovec et al., 1999). Those in mindful states may be more likely to interpret these concerns with non-judgmental acuity. This helps to remove the need to engage in cognitive loops and allowing for the de-escalation of associated distress by removing ambiguity toward the root of said concerns (Bishop et al., 2004; Delgado et al., 2010). Research findings indicate that mindful individuals experience more positive affect and less repetitive thinking, thereby increasing cognitive resources and skills available for addressing worry (Teasdale et al., 1995; see also meta-analysis from Gu et al. 2015). Thus, the need to address cognitive variables associated with reevaluating worry in the face of distress becomes increasingly important.

Mindfulness and WMC

As described above, working memory represents the ability to manipulate and maintain information, often in the face of distraction or interference (Conway et al., 2005; Kane et al., 2004). *Working memory capacity* (WMC) refers to the storage component of working memory and has been shown to be compromised by anxiety, stress, and worry, while mindfulness has been shown to be a potential protective factor against this degradation (Jha et al., 2010). Specifically, mindfulness is a metacognitive skill in which an individual may practice sustained attention and awareness, experience distractions, and return attention after each distraction

(Wells, 2002; 2011). Whereas in the previous section I discussed correlational and causational relations between mindfulness and worry, the following section will discuss the effect of mindfulness on WMC while drawing from three different methodological frameworks for assessing mindfulness: self-report/cross-sectional correlations, therapeutic interventions, and mindfulness inductions.

Trait Mindfulness

Cross-sectional self-report findings are promising for supporting the relationship between mindfulness and WMC. In a sample of nursing students, Dubert et al. (2016) tested for associations among trait mindfulness (MAAS; Brown & Ryan, 2003), the Reappraisal subscale of the Emotion Regulation Questionnaire (Gross & John, 2003), and Automated Operation Span scores (Unsworth et al., 1989). In the OSpan participants are asked to store an integer or word which is followed by a mathematical expression that the participant must determine as being true or false. After participants have stored all the integers and made all judgements on mathematical expressions, they are then asked to recall the inegers in the order they were presented. This marks the completion of a trial. Results indicated a medium-sized positive association between mindfulness and both WMC and emotion regulation. Structural equation modeling indicated a direct effect of mindfulness on both emotion regulation and WMC such that emotion regulation and WMC increased (Dubert et al. 2016). However, in a separate, similar study that used a sample of medical students, Black et al. (2011), found a nonsignificant association between automated OSpan and MAAS scores, as well as non-significant associations between both the automated OSpan, MAAS, and the Positive and Negative Affect Scale.

Both studies investigated a similar population (i.e., health education students) and both used the MAAS and automated OSpan. Whereas Dubert et al. (2016) assessed emotion regulation strategies, Black et al. (2011) assessed levels of positive and negative affect. Furthermore, Dubert et al. conducted their study in-person, while the entirety of Black et al.'s study was administered online. It may be possible that participants who take cognitive batteries online (in their personal environments) may be prone to distraction or other confounds not present in the laboratory setting. This could have contributed to Black and associates' lack of significant findings. Overall, the evidence investigating associations between trait mindfulness and WMC is mixed. Future research should explore other ways of measuring trait mindfulness and WMC. Specifically, mindfulness assessments should cover theoretical axioms of mindfulness in appropriate depth, while WMC measures should allow for interpretation from both domain general and domain specific perspectives.

Mindfulness Interventions for WMC

Hall (2019) investigated the impact that two MBIs, *Acceptance Based Behavioral Therapy* and *Applied Relaxation*, had on improving WMC as measured by the OSpan in a sample with generalized anxiety disorder. Hall hypothesized that the mechanism of worry reduction would come from the replacement of negatively valanced repetitive thoughts by a present-oriented, non-judgmental, and accepting perspective. Results indicated a moderate yet nonsignificant association between both interventions and improvement in WMC. These findings contrast with research by Hayes-Skelter and Roemer (2013), who found significant improvements on the OSpan using both Acceptance Based Behavioral Therapy and Applied Relaxation techniques. The Acceptance Based Behavioral Therapy condition in the Hayes-

Skelter and Roemer study showed the greatest improvement. Hall noted a small sample size and the single, as opposed to repeated, use of the OSpan throughout the study as a potential explanation for divergent findings.

Research has predominantly supported the theory that MBIs improve scores on span tasks used to assess WMC. Jha et al. (2010) investigated this relationship by comparing civilian and military controls against a mindfulness training military condition. These conditions were compared on WMC measured by the OSpan and affect measured by the Positive and Negative Affect Scale during a pre-deployment interval. Results indicated that those who practiced more mindfulness training homework during an eight-week period experienced less WMC degradation when compared to a military control group. It was also found that WMC mediated the influence of mindfulness training on negative affect such that mindfulness training was now associated with a decrease in negative affect. The authors suggest that this outcome represents the protective effect that mindfulness has on stress-related degradation of WMC.

Roeser et al. (2013) investigated the impact of an eight-week mindfulness training program in a sample of teachers on a variety of outcomes including WMC assessed by the OSpan. Results after the intervention and upon a three-month follow-up indicated that the intervention group had higher mindfulness scores as assessed by the FFMQ and had greater WMC scores.

Similar results have been found in less time-intensive interventions with students. For example, Mrazek et al. (2013) gave students a two-week mindfulness training course and found better scores on the OSpan and verbal GRE when compared to a control group. Banks et al. (2015) conducted a one-week mindfulness training intervention and compared outcomes on the OSpan before and after the intervention, while also comparing the scores against a relaxation

training group. The final OSpan task was preceded by a writing stressor task; the authors compared the groups and found that the mindfulness training group experienced less WMC degradation in response to the stress-writing task when compared to the relaxation training group. The authors concluded that the mindfulness training, but not relaxation training, protected against degradation of WMC because of reduced mind-wandering.

Finally, Quach et al. (2016) compared outcomes of adolescents' stress, anxiety, and WMC across three conditions: a four-week mindfulness training intervention, a hatha yoga condition, and a control condition. The authors found no difference between groups on outcomes for stress and anxiety; however, the mindfulness training group showed significantly higher scores on the OSpan compared to the other groups. Altogether, these findings from extended mindfulness interventions suggest that mindfulness may serve as a protective or bolstering factor for WMC; however, there are some findings resulting from other approaches (namely, single session mindfulness inductions) which offer a different perspective on the mechanisms behind the relationship.

In two meta-analyses looking at the relationship between MBIs and a variety of cognitive variables, including working memory, a significant relationship was not found between the intervention and working memory performance. However, the number of intervention sessions moderated this relationship; more sessions attended was associated with improved working memory (Im et al., 2021; Yakobi et al., 2021). In a meta-analysis by Im et al. (2021), more intervention sessions nominally improved performance on working memory tasks, but the effect was non-significant. The authors also expressed that MBI type moderated treatment effect. In addition, the authors further suggested that the lack in significant findings for increased sessions, and the moderation found by MBI type, may have been related to the type of attentional skill

cultivated through MBIs. Externally cued attention assessed in their tasks qualitatively differed from the internally-focused attention cultivated through MBIs. These findings suggest that reliable interpretations of change in working memory, as it relates to the influence of MBIs, should acknowledge the different types of attentional skills being targeted in both the MBIs and tasks used to assess working memory change. Furthermore, despite some non-significant findings, it does seem likely that the benefits of mindfulness practice are stronger when mindfulness is practiced more consistently.

Findings related to improved performance over consistent mindfulness practice are iterated by Morrison and Jha (2015) in their book *Handbook of Mindfulness and Self-Regulation*, wherein mindfulness is suggested to have a positive impact on performance during more difficult working memory tasks when mindfulness is practiced over time. Morrison and Jha posit two potential accounts for this: (1) mindfulness reduces reactivity to information in working memory and (2) mindfulness expands WMC.

Mindfulness Inductions

In a review of two previous studies, Quek et al., (2021) investigated the effects that a single 15-minute mindfulness breathing audio induction/training had on measures of WMC (OSpan, symmetry span (SSpan)). Results indicated that there were no differences on WMC measures between induction/training groups and controls. The authors interpret the results to suggest that a single mindfulness exercise is not enough to show significant improvement in WMC. This is supported by previous research which suggests that a short mindfulness exercise is not sufficient to truly induce mindfulness without concurrent education (Goldberg et al.,

2016). This highlights a limitation, that it is unclear whether mindfulness induction was actually achieved.

Other research has used different paradigms for inducing mindfulness and for measuring WMC. Ma et al. (2021) compared a *focused-attention meditation* group with an open monitoring meditation group on WMC as measured by the *N*-back test (Sweet, 2011). The *N*-back is a working memory assessment that involves holding a stimulus in short-term memory while being presented with a new stimulus. The goal is for the participant to identify if the new stimulus is the same as the initial one. The new and initial stimulus can be separated by any number of stimuli in-between (*N*), typically ranging from one to three. Over a series of experiments, findings indicated that only the focused attention meditation group showed significant improvement on the *N*-back test. To be specific, improvement was only found for the medium (2-back) trials, suggesting that the benefits of this mindfulness induction are limited within a middle ground of capacity demand.

Yamaya et al. (2021) also investigated the efficacy of focused attention meditation improving working memory as assessed by a reading span task. The authors posited that both WMC and focused attention meditation share activation of certain neural substrates including the dorsolateral prefrontal cortex. Participants were split into either a 15-minute focused attention meditation audio induction or a mind-wandering audio induction group. They were then compared on their correctness in response to the reading span task. Near-infrared spectrometry was used to gauge the blood flow in and subsequent activation of the dorsolateral prefrontal cortex in all conditions. Results indicated that the bilateral dorsolateral prefrontal cortex was activated during the intervention for the focused attention meditation group and not the mind-wandering group. A positive correlation was found between dorsolateral prefrontal cortex

activation and WMC in both groups during the reading span. Results suggest that both meditative focused attention and WMC share substrates in the dorsolateral prefrontal cortex and that focused attention meditation may be useful as a brief induction for improving WMC performance.

Further investigating neural correlates associated with WMC, Stout et al. (2017) used a facial recognition task completed during an fMRI scan to observe allocation of working memory resources in a high trait-anxiety sample. Results indicated heightened activity in the amygdala and decreased activity in the fusiform cortex and prefrontal cortex (areas used in facial recognition) when compared to a control group. This outcome suggests a misallocation of working memory resources in highly anxious individuals. Taken in context with other research discussed, it seems that anxiety and worry have the effect of drawing cognitive resources away from brain regions needed in performing cognitively demanding tasks, while some mindfulness practices have been shown to increase activation in brain regions used for tasks which utilize WMC.

Summary and Future Directions

Worry is a facet of anxiety that entails cognitive distress about repetitive negative thoughts. Excessive worry is associated with several negative outcomes and is a characteristic feature for many affective disorders. Worry is also associated with poorer performance on WMC batteries while being theoretically and empirically linked to disruption of specific WMC processes. Furthermore, mindfulness and worry typically have an inverse relationship.

Mindfulness and WMC also share strong theoretical and empirical links with both concepts showing overlap in the involvement of intentional and attentive components (Shapiro et

al., 2006). It is suggested that worry may degrade WMC performance along with increasing stress and anxiety. Research investigating mindfulness as a protective factor for WMC has shown promising results, with mindfulness's capacity for stress reduction seen as a large contributing factor to the relationship (Banks et al., 2015). More research is needed to investigate mindfulness as a protective factor against worry via enhancement of WMC, given some results which have been non-significant and inconclusive.

Worry may impair WMC by drawing on limited cognitive resources. Mindfulness may reduce worry by increasing positive affect and decreasing the maladaptive repetitiveness of thoughts about the future--allowing for more adaptive planning and problem-solving sequences as implicated by brain activation patterns in those who are highly anxious and those engaged in mindfulness practice (focused attention meditation specifically). While much of this body of research has focused on dispositional mindfulness traits and mindfulness interventions or inductions, less research has investigated individual differences in routine intentional mindfulness-related activities (e.g., yoga and exercise as specific focus of the study; Quach et al., 2016), and none to my knowledge have assessed accumulative self-reported mindfulness-based behaviors in addition to dispositional mindfulness. For this proposed study, I will test the moderating effect of mindfulness disposition (i.e., to assess replication of prior findings), as well as the degree of self-reported mindfulness behaviors engaged in a typical week, on the relationship between worry and WMC. I will also focus on an undergraduate population. This population has increased risk for distress and impairment in the face of new responsibilities and circumstances. In addition, developmental changes in the frontal lobe (specifically the dorsolateral prefrontal cortex), which has been found to be associated with executive functioning skills including inhibitory processes, cognitive flexibility and working memory (Barbey et al.,

2013), continue to occur throughout early adulthood (Lenroot & Giedd, 2006). For this proposed study, undergraduate students will be recruited from the University of Tennessee at Chattanooga and will be asked to complete (1) a self-report battery of trait questionnaires on worry, mindfulness, and mindfulness activities and (b) online batteries of WMC performance (including verbal and visuospatial WM).

Hypotheses

The following hypotheses were tested: (1) trait worry will negatively relate to trait mindfulness, and trait mindfulness will be positively related to both verbal and visuospatial WM performance; (2) trait worry will be negatively related to both verbal and visuospatial WM performance, consistent with prior research. In addition, it was hypothesized that a newly designed measure, the Mindful Activities Questionnaire (MAQ) would demonstrate: (3a) four factor loadings aligned with specific subfacets of mindfulness; (3b) good reliability (3c) and good convergent and discriminant validity. (4) Next, should Hypotheses 3a-3c be supported, it was hypothesized that the frequency and number of typical weekly mindfulness behaviors (i.e., MAQ scores) would negatively relate to worry and positively relate to both verbal and visuospatial WM performance. Finally, it was hypothesized that (5) trait mindfulness and (6) mindfulness behaviors will relate in similar strength and direction to both verbal WMC and visuospatial WMC, consistent with domain-general theory. Exploratory analyses tested whether (E1) trait mindfulness and (E2) mindfulness behaviors will each significantly moderate the association between worry and each of the WMC measures, such that the worry-WMC relation would be weaker for individuals with greater mindfulness disposition and activities.

CHAPTER II

METHODS

Participants

A power analysis was conducted using G*Power (Faul et al., 2007, 2009) for R^2 increase (interaction variable) in a fixed multiple linear regression fixed model, assuming a moderate effect size (f = .15; power = .80) with one tested predictor (interaction variable) and three total predictors (mindfulness, worry, and their interaction term). A sample size of 70 was revealed to achieve statistical significance.

70 participants were recruited for this study via UTC SONA undergraduate research portal, with participants receiving class credits as compensation. Of the 70 participants, 89% (n = 62) recorded responses for all tasks and questionnaires with two participants missing operation span responses and six missing symmetry span responses due to technology errors. Ages ranged from 18-48 (M = 21, SD = 4.12), 80% (n = 56) identified as women, 15.7% (n = 11) as men, and (n = 3) participants identified as either transgender or gender non-conforming. Also, 77% (n = 54) identified White, or European American, 17% (n = 12) as Black or African American, (n = 8) as Hispanic/Latino, and (n = 2) as Asian.

Measures

WMC Assessments

Participants were asked to complete a cognitive battery in order to assess working memory capacity (WMC). Tests in this battery include the Operation Span (OSpan) and Symmetry Span (SSpan) with instruction and resources for applied use provided by Stone and Towse (2015). The software and necessary executable files for these tests are open source and require an updated Java runtime application, with the recommended being Java Runtime Environment V 8. (JRE). The framework for the tasks is originally provided by Tatool (von Bastian et al., 2013), which can be used to modify scripts from default settings within the tasks. Otherwise, all necessary components are provided in a .jar file which is available on the authors' project website: http://www.cognitivetools.uk/cognition/. Results for each participant were exported as a CSV file.

Verbal WMC: Operation Span (OSpan). The OSpan was created by Turner and Engle (1989) and is characterized as a verbal complex span task. The OSpan is being used in this study to measure performance on the verbal domain of WMC. It is a frequently used test with modified and updated versions. The OSpan task to be used in the proposed study is provided by Stone and Towse (2015) and. Participants are first asked to mentally "store" (i.e., remember) an integer presented to them. This is followed by a processing phase, wherein participants are given a simple mathematical expression (e.x. 17 - 5 = 13) and asked to determine whether the expression is *true* or *false*.

Mathematical expressions are randomly generated with outcomes within a range of set values (10-99) and have an equal chance of being either true or false. After two to five more

storage-process elements, participants are asked to recall the storage element integers in correct serial positioning. This constitutes a trial with six trials for every possible range of storage-process elements, resulting in a total of 24 trials per participant. The accuracy and speed of responses within these trials are indexed and averaged to give scaled output for assessing complex verbal WMC. Specifically, the following performance variables can be obtained: full trial accuracy, proportion correct, number of successes, processing accuracy, and processing median response time, max span, and span correct 2-5.

Full trial accuracy is a composite score which uses success within the recall and processing phases to indicate success while assigning greater weight to success within trials of a higher width (i.e. more integers to recall and equations to judge). The full trial accuracy score was used as a primary variable for representing span task performance because it is a commonly used absolute scoring method, which offers an opportunity to easily compare results to those found in the literature (Đokić et al, 2018). It also places a great emphasis on being able to maintain width of storage despite processing interference, which highlights the capacity component of WM.

Proportion correct represents the number of digits correctly recalled divided by the total of numbers to be recalled. This scoring method was not chosen because recall without accounting for the ability to handle interference appears to be more representative of short-term memory as opposed to the dynamic system that is WM.

Number of successes is the same as proportion correct except there is no division by total of numbers to be recalled; it was not chosen for the same reason.

Processing accuracy is obtained through the same method as proportion correct, except successes are tallied and divided within the outcomes for the processing phase as opposed to the storage/recall phase. This method was not chosen as it does not address recall success.

Processing median response time gives the median response time for all processing phases in each trial. This measure was used as part of a primary variable for representing span task outcomes in that full trial accuracy scores are divided by processing median response times to give an index of efficiency. This measure was chosen because efficiency is thought to show greater variation in response to anxiety related cognitive stress as compared to an accuracy measure (Eysenck and Calvo, 1992).

Max span represents the highest storage width at which a participant answered all parts of a trial correctly. This measure was not chosen as it does not index participant performance across the task. Rather, it shows the highest width at which a participant performed effectively.

Span correct 2-5 represents four outcome variables that indexes the number of fully accurate trials at a respective width. These variables were not chosen because they are not composite scores. Finally, the OSpan has been found to correlate well with other measures of WMC, showing good internal consistency and test retest reliability with Chronbach's alphas above .70 (Unsworth et al., 2005).

Spatial WMC: Symmetry Span (SSpan). The SSpan task was created by Frank Arnould and first employed in a noteworthy WMC research design by Kane et al. (2004). The SSpan was used in this study to measure performance on the spatial domain of WMC. For the proposed study, the SSpan task was retrieved from the open source cognitive batteries project by Stone and Towse (2015). Described as a complex visuospatial span task, the SSpan task asks

participants to remember the location of certain cells in a 4X4 grid representing the storage component. Afterwards participants are shown an 8X8 grid pattern and asked to indicate whether the pattern is symmetrical on the vertical axis; this represents the processing component. This is followed by two to five more storage-processing elements. Afterwards, participants are asked to indicate the relevant cells from the storage components in serial positioning. This constitutes a trial, with six trials for every possible range of storage-process elements, resulting in 24 trials per participant. The accuracy and speed of responses within these trials are indexed and averaged to give scaled output for assessing complex spatial WMC. The same outcome variables were obtained as those mentioned in the OSpan description. Full trial accuracy and performance efficiency are the primary outcome variables used to represent SSpan scores for the same reasons mentioned previously.

The SSpan is generally considered to be well validated (Redick et al., 2012). It has displayed good test-retest reliability, with criterion validity for SSpan also being well established. The SSpan is shown to be a good predictor of outcomes on other WMC tests including the OSpan as well as measures of fluid intelligence including the Raven Progressive Matrices Task. It is found to have good internal consistency with reliability estimates from Chronbach's alpha well above .70 (Unsworth et al., 2009).

Primary Self-Report Measures

Participants were asked to complete a series of questionnaires related to mindfulness, worry, anxiety, and demographics. All self-report measures will be administered in a computer lab via Qualtrics.

Demographic Questionnaire (constructed by the principal investigator). Participants were asked to indicate their gender, race/ethnicity, age, current GPA, anticipated grades for current semester, and year in school in order to understand basic demographic characteristics of the sample.

Penn State Worry Questionnaire (PSWQ). The PSWQ is a 16-item instrument created and validated by Meyer et al. (1990) in order to measure trait worry. Responses are given on a 1-5-point Likert Scale wherein participants are asked to indicate the degree to which a statement applies to them with responses ranging from *Not at all typical of me* to *Very typical of me*. Examples of items include "My worries overwhelm me" and "I find it easy to dismiss worrisome thoughts". The PSWQ is described as having high internal consistency and good test-retest reliability. It has been found to be well validated in both clinical and non-clinical adult as well as student populations, having strong positive correlations with measures of emotional disturbance and maladaptive coping. Finally, the PSWQ has been shown to positively correlate with measures of generalized anxiety disorder severity and other diagnoses (Brown et al., 1992; Liu et al., 2022). In the current study, the PSWQ showed excellent internal consistency ($\alpha = .94$).

Five Facets of Mindfulness Questionnaire (FFMQ). The FFMQ is a 39-item instrument created by Baer et al. (2006). It contains five facets of mindfulness, which are measured as sub-scales: Observing, Describing, Acting with Awareness, Non-Judging of Inner Experiences, and Non-Reactivity to Inner Experiences. Responses are given on a 1-5 point Likert Scale, wherein participants are asked to indicate the extent to which they believe statements to be true about themselves, with responses ranging from *Never or Very Rarely True* to *Very Often or*

Always True. Examples of questions on the FFMQ include, "When I'm walking, I deliberately notice the sensations of my body moving" and "I disapprove of myself when I have irrational ideas". In analyzing the factor structure of the FFMQ, all facets were found to load significantly on the general mindfulness construct. The FFMQ displays strong convergent validity by having good positive correlations with other mindfulness questionnaires. The internal consistency for each factor is found to be high with Chronbach's alphas > .80. (Baer et al., 2006; Christopher et al., 2012). In the current study, subscales showed good internal consistency ($\alpha = .87$). The rationale for choosing the FFMQ as the primary mindfulness outcome measure is that it captures more of the axioms of mindfulness thought to be relevant in connection with WMC and worry, those being intention (attitude) and awareness. This also makes the FFMQ a good measure for assessing convergent validity within the MAQ.

Mindful Activities Questionnaire (MAQ). Despite thorough review of the literature, I was unable to find an established measure of frequency and number of mindful activities. Thus, for the purposes of this study, the MAQ was developed and psychometrically evaluated. The MAQ is a 18-item scale that asks participants how many days during the week they have engaged in mindful activities, and how much time they spend on said mindful activities during the past week. These activities include *physical activities* (exercise that elevates heart rate for an extended period of time; e.g., jogging/running, yoga, weight lifting), *meditative activities* (intentional and extended focus on sensations without acting on them; e.g. meditation, prayer, reading), *expressive activities* (tasks that serve little purpose beyond expression (examples include drawing, dancing, journaling), and *altruistic activities* (actions that recognize one's role in others' lives; e.g., community service, mentorship, and helping others).

I aimed to cover the axioms of mindfulness with intention, attention and attitude being represented respectively with the types of activities I selected. Physical activity taps into the interoceptive facet of mindfulness wherein it presents an opportunity for one to be uniquely focused on bodily sensations in a way that promotes non-judgmental awareness (Ullrich-French & Cox, 2020). Meditation represents the formal practice of mindfulness as it promotes awareness of one's inner experiences drawing one's focus to oneself in a non-judgmental manner (Kabat-Zinn, 2005). Creative endeavors have been linked to mindfulness as they represent a momentary dismissal of fear and judgement once again promoting non-judgmental awareness of inner experiences with creativity endeavors having been described as entering states of mindfulness and enhanced through mindfulness training (Chiesa et al., 2011). Giving or compassion/altruism taps into the attitudinal component of mindfulness, with giving being a means of expressing empathy that develops from cultivated mindfulness (Iwamoto et al., 2020). Responses are given on a series of 0-7 Likert-type scales. Each item requires two responses on this scale. In the first set of responses, participants indicate the number of days during the week in which they engage in an activity. In the second set of responses, participants use the same Likert-type scale to indicate how much time was spent on the activity during the days indicated previously. The MAQ is split into two sets of activities which have their own range of times which the Likert-type scale is used to indicate. For the first set 1 indicates ten minutes and 7 indicates more than two hours. In the second set, 1 indicates five minutes and 7 indicates more than an hour. Scores are calculated by multiplying the number of days indicated for a specific activity by the typical amount of time spent on said activity in a given day. Please see Appendix F for a copy of the MAQ, as administered to participants.

Applied Mindfulness Processes Scale (AMPS). The AMPS, created and validated by Li et al (2016), is a 15-item process measure used to quantify how often respondents use mindfulness practices in response to challenges in daily life, with emphasis on three applied process domains: *decentering*, *positive emotion regulation*, and *negative emotion regulation*. Responses are given on a 0–4 Likert scale, with 0 indicating *never*, and 4 indicating *almost always*, with participants being asked to express the frequency with which they have engaged in specific mindful practices within the past 7 days. Examples of statements of the AMPS include "relax my body when I am tense" and "stop my unhelpful reactions to situations". The AMPS, while usually considered for use within mindfulness behavioral interventions, has been validated for application within general mindful practice. The AMPS has also been described as a good measure to use in conjunction with trait measures of mindfulness to determine which mindfulness processes are predictive of mindfulness as a single construct. In the present sample, the AMPS showed excellent internal consistency ($\alpha = .91$). The AMPS was used in the present study to assess convergent validity for the MAQ.

Mindfulness Attention Awareness Scale (MAAS). The MAAS is a 15-item instrument created and validated by Brown and Ryan (2003) to assess trait-mindfulness. Responses are given on a 6 point Likert Scale, with the prompt for each item asking the participant to indicate the frequency of particular mindfulness related experiences. Responses ranged from almost always to almost never. Examples of specific items include "I could be experiencing some emotion and not be conscious of it until sometime later" and "I forget a person's name almost as soon as I've been told it for the first time". Of the axioms of mindfulness, the MAAS mostly assesses attention through acting with awareness of the present moment. This instrument

characteristically strays away from the other axioms related to attitude and judgment so as to remain neutral. The MAAS is considered to be well validated in student populations and it is shown to be moderately correlated with measures of awareness highlighting that it assesses a related yet distinct construct. In addition, MAAS scores are found to be negatively correlated with self-consciousness, social anxiety, and rumination which aligns with findings that more mindful individuals tend to struggle less with these cognitive habits. Finally, the MAAS has also been found to be positively correlated with measures of wellbeing, which aligns with past research suggesting that mindful individuals tend to be happier and healthier (Brown & Ryan, 2003; MacKillop & Anderson, 2007). This measure was primarily used to assess convergent validity within the MAQ and demonstrated excellent internal consistency in the present sample ($\alpha = .91$).

Mind Wandering Questionnaire (MWQ) The MWQ is a 5-item instrument created and validated by Mrazek et al., (2013) and was created to assess the construct of mind wandering specifically. It has been shown to have high internal consistency and high convergent validity with other mind wandering measures and related constructs. Examples of questions on the MWQ include “I have difficulty maintaining focus on simple or repetitive work” and “I do things without paying full attention”. Responses are given on a one to six Likert scale used to address frequency of mind wandering behavior, with 0 indicating *almost never* and 6 indicating *almost always*. This measure was primarily used to assess discriminant validity of the MAQ and demonstrated good internal consistency in the present sample ($\alpha = .88$)

Exploratory Self-Report Measures

In addition to the self-report measures of mindfulness, participants were also asked to complete exploratory measures related to anxiety, stress, and depression. These measures may offer insight as to the relationship between worry, mindfulness, and WMC, while also helping to identify participants whose responses may act as outliers.

Generalized Anxiety Disorder 7-Item Scale (GAD-7). The GAD-7 is a seven item self-report questionnaire used to assess an individual's anxiety symptoms over the past two weeks developed by (Spitzer et al., 2006). Responses are given on a range of 0 (*not at all*) to 2 (*for several days*), with participants indicating the degree to which they have been bothered by certain feelings or instance, Example questions/statements include "feeling nervous, anxious, or on edge" and "feeling afraid as if something awful might happen". The GAD-7 is well validated for sensitivity and specificity toward generalized anxiety disorder and is described as having moderate validity for detecting most anxiety disorders. Furthermore, the GAD-7 shows high convergent validity with the PSWQ with both displaying a Cronbach's alpha > .80 (Williams, 2014). In the present sample the GAD-7 showed excellent internal consistency ($\alpha = .93$).

Anxiety Sensitivity Index-3 (ASI-3). The ASI-3 created by Taylor et al. (2007) is an 18-item measure which is said assess beliefs about feared consequences associated with anxiety symptoms. Responses are given on a range from 0 *very little* to 4 *very much*, with example questions/statements including "it scares me when I become short of breath" and "it scares me when I am unable to keep my mind on a task". The ASI-3 is comprised of three subscales referring to fear of social concerns, physical symptoms and cognitive dysfunctions. Internal

consistency of the three subscales ranges from adequate to good and reliability for the total score was found to be excellent (α = .93). Furthermore, the ASI-3 shows good convergent validity as its items correlate highly with the PSWQ (Taylor et al., 2007; Wheaton et al., 2012). In the present sample, the ASI-3 showed excellent internal consistency (α = .92).

Depression, Anxiety, and Stress Scale (DASS). The DASS, created and validated by Parkitny and McAuley (2010), is a 42-item measure of the magnitude of three negative emotional states, those being depression, anxiety, and stress. Participants are asked to rate how well specific statements apply to them over the past week. Ratings are indicated on a range from 0 *did not apply to me at all* to 4 *applied to me very much or most of the time* with example questions/statements including "I found myself getting upset by quite trivial things" and "I found it difficult to work up the initiative to do things". Internal consistency was found to be high in all of the subscales, construct and convergent validity of the anxiety and depression subscales were found to be high as well. Finally, external validity is supported through robust findings in clinical as well as non-clinical samples (Lovibond & Lovibond, 1995; Parkitny & McAuley 2010). In the present sample the DASS showed excellent internal consistency for depression (α = .96), anxiety (α = .90), and stress (α = .95).

Procedure

This experiment was conducted via Qualtrics and a JRE application. Students signed up online to participate via SONA systems through the UTC Department of Psychology. Participants were run in batches of three to five individuals per appointment session. Upon arrival, they were seated at a computer and asked to provide their UTC email to a researcher,

which was used to supply a link to a survey. First, participants opened the linked survey and entered the survey password provided by the researcher. Next, participants reviewed the informed consent document.

After obtaining informed consent, the researcher began playing an instructional video and/or PowerPoint slideshow to help participants launch the *cog-tasks.jar* file and framework application, Tatool, on each of their assigned computers. Next, participants were directed to create a demo account for brief practice with the tasks before they were tested. They were then directed to upload the *modified-operation-span.xml* file. After uploading the file, participants were directed to complete 12 trials of the operation span (OSpan) task. These steps were repeated with the *modified-symmetry-span.xml* file, which enabled participants to practice 12 trials of the symmetry span (SSpan) tasks. After both demos were completed, participants used their unique and assigned participant IDs to create new accounts, which was followed by uploading the same .xml file used in the demo. Participants completed all 24 trials for each of the OSpan and SSpan tasks and were asked to upload their de-identified output files to their unique Qualtrics survey to later download and compile for analyses. A two to five minute break was provided after completion of each task to allow participants to catch up with each other and to provide a brief rest period.

Following completion of the span tasks, participants were asked to complete self-report measures (PSWQ, FFMQ, AMPS, MAQ, GAD-7, ASI-3, DASS, MAAS, and MWQ) in the survey. Lastly, participants filled out the demographic questionnaire before they were taken to the debriefing page. The duration of participation was approximately 75 minutes.

Data Analytic Plan

All analyses were conducted using SPSS Statistics Version 22.

Primary Analyses

Hypotheses One and Two. Bivariate correlations were run to test the associations among: **(1)** the FFMQ, PSWQ, OSpan scores, and SSpan scores; and **(2)** PSWQ, OSpan scores, and SSpan scores.

Hypothesis Three. (a) A Kaiser-Meyer Olkin (KMO) test was used to determine fitness for factor analysis, while an exploratory factor analysis was used to reveal factor loading scores and eigenvalues. (b) A common-fit (chi-square) test of model fit, and Spearman-Brown formula test were used assess reliability, while (c) bivariate correlations between the MAQ and the FFMQ, AMPS, MAAS, PSWQ and MWQ were used to assess convergent and discriminant construct validity.

Hypothesis Four. Pending psychometric support of the MAQ per Hypotheses 3a-3c, bivariate correlation analyses tested the relations between the MAQ and the PSWQ and OSpan and SSpan scores.

Hypotheses Five and Six. Two hierarchical multiple linear regression were run, while controlling for worry; the OSpan and SSpan scores were compared on how they relate to FFMQ and MAQ scores, respectively. For these analyses, span scores was entered into Step 1, and PSWQ scores was entered into Step 2.

Exploratory Analyses

Multiple linear regression analyses tested the moderating effect of **(E1)** FFMQ scores and **(E2)** MAQ scores [pending psychometric support] on the relationship between PSWQ scores and both OSpan and SSpan scores, The moderation models were run in PROCESS (Hayes, 2012). Upon running these models, assuming the observed FFMQ x PSWQ, and MAQ x PSWQ interactions were significant, model significance, *b* weight for the interaction term, and significant R^2 changes were interpreted in addition to simple slope analyses.

CHAPTER III

RESULTS

Hypothesis One

Bivariate correlation results indicated that PSWQ scores were significantly, negatively, and moderately related to FFMQ scores, consistent with prior research (e.g., Chambers et al., 2008) and as hypothesized, $r = -.42$, $p < .01$. Follow-up analyses were conducted to explore relations between the PSWQ and FFMQ subscales (i.e., facets of mindfulness). Results indicated that three subfacets had moderate negative associations with the PSWQ: *acting with awareness*, $r = -.38$, $p < .01$, *non-judgement of inner experiences*, $r = -.38$, $p < .01$, and *describing*, $r = -.32$, $p < .01$. There was one small negative association with *non-reactivity to inner experiences*, $r = -.27$, $p = .02$, and the *observing* subfacet was non-significant. Bivariate correlations also indicated that full trial accuracy and efficiency span scores for the OSpan and SSpan were non-significantly related to FFMQ scores; OSpan full trial accuracy $r = -.07$, $p = .55$, OSpan efficiency $r = -.07$, $p = .56$, SSpan full trial accuracy $r = -.09$, $p = .50$, SSpan efficiency $r = -.09$, $p = .50$. Follow-up analyses were conducted to explore the relations between FFMQ subfacets and span scores which revealed non-significant associations with the exception of OSpan full trial accuracy and the *acting with awareness* subfacet, which showed a weak negative association $r = -.24$, $p < .05$, leaving this hypothesis partially supported.

Hypothesis Two

Bivariate correlation results indicated that PSWQ scores were non-significantly, negatively, and weakly related to both OSpan and SSpan full trial accuracy and efficiency, failing to support the hypothesis; OSpan full trial accuracy, $r = -.05$, $p = .67$, OSpan efficiency, $r = -.06$, $p = .60$, SSpan full trial accuracy, $r = -.12$, $p = .34$, SSpan efficiency, $r = -.10$, $p = .43$.

Hypothesis Three

Hypothesis Three (a): Factor Analyses

An Exploratory Factor Analysis was conducted using a principal components method and varimax rotation to determine potential factor structure. The number of extracted factor components was set to four; see Table 1 for obtained eigenvalues and Table 2 for obtained factor loadings.

Table 1 Eigenvalues, Percentages of Variance and Cumulative Percentage for Factors for 18 MAQ Items

Factor	Eigenvalue	% of Variance	Cumulative %
1	3.79	21.07	21.07
2	2.67	14.81	35.87
3	1.74	9.65	45.53
4	1.42	7.86	53.39

Table 2 Factor Loadings for Varimax Rotated Four-Factor Solution for 18 MAQ Items (N = 70)

	Factor Loading			
Components	1	2	3	4
Journaling$_{e}$	**.90**	.14	.08	-.001
Helping friends and family$_{p}$	**.85**	.15	-.08	.002
Playing games (video, board, etc..)$_{e}$	**.81**	-.04	-.08	.16
Jogging/Running$_{p}$	.27	**.83**	-.02	-.02
Yoga$_{p}$	.52	**.60**	.18	-.08
Weight Lifting$_{p}$	-.17	**.75**	-.11	-.18
Drawing/Painting$_{e}$	.04	**.83**	.08	-.07
Meditation$_{m}$	-.02	**.54**	.20	.30
Formal charity work$_{a}$	-.17	.12	**.59**	-.09
Serving as a mentor$_{a}$	.26	.07	**.37**	.14
Swimming$_{p}$	-.09	.20	**.49**	-.24
Dancing$_{e}$	.29	-.02	**.42**	.30
Relaxing (no other activity)$_{m}$	-.04	-.09	**.57**	.19
Playing with pets$_{e}$	.36	-.03	**.48**	-.01
Playing sports games$_{p}$	.40	-.05	.33	**.52**
Prayer$_{m}$	.17	.29	-.34	**.52**
Reading$_{m}$	.34	-.19	.09	**.35**
Listening to others' frustrations$_{a}$	-.15	-.11	.04	**.85**

Note. Subscript next to components indicates expected loadings with "$_{e}$" indicating expressive activity, "$_{a}$" indicating altruistic activity, "$_{p}$" indicating physical activity, and "$_{m}$" indicating meditative activity.

The factors extracted accounted for 53.40% of variance in responses. Some of the components loaded highly onto multiple factors. In this case it is sometimes considered best practice to delete those items which have multiple high loadings within .15 (Black & Babin., 2019, Le & Cheong, 2010). In the case of the Yoga item, it appears to have very close loading values on two factors; however, removing the Yoga item would be remiss for an assessment of mindfulness behaviors as it is one of the more widely recognized mindfulness activities. With the exception of the Yoga item, all other items with high cross loadings were removed (i.e. serving as a mentor, dancing, reading, playing sports games, and playing with pets). This yielded a 13-

item solution for eigenvalues can be seen on Table 3, and factor loadings can be seen Table 4. Additionally, a single factor solution was run for comparison seen on Table 5.

Table 3 Eigenvalues, Percentages of Variance and Cumulative Percentage for Factors for 13 MAQ Items

Factor	Eigenvalue	% of Variance	Cumulative %
1	3.44	26.44	26.44
2	2.23	17.16	43.60
3	1.46	11.22	54.82
4	1.32	10.12	64.93

Table 4 Factor Loadings for Varimax Rotated Four-Factor Solution for 13 MAQ Items (N = 70)

	Factors			
Components	1	2	3	4
Journaling$_{e}$	**.91**	.11	.03	-.01
Helping friends and family$_{a}$	**.89**	.11	-.06	.02
Playing games (video, board, etc..)$_{e}$	**.81**	-.10	-.10	.11
Jogging/Running$_{p}$	.25	**.86**	-.07	.03
Yoga$_{p}$	.54	**.59**	.13	-.09
Weight Lifting$_{p}$	-.19	**.80**	-.12	-.10
Drawing/Painting$_{e}$	.07	**.83**	.15	.01
Meditation$_{m}$	.05	**.47**	.31	.36
Formal charity work$_{a}$	-.10	.07	**.68**	-.07
Swimming$_{p}$	-.02	.18	**.65**	-.30
Relaxing (no other activity)$_{m}$	.05	-.19	**.68**	.26
Prayer$_{m}$	.26	.18	-.05	**.70**
Listening to others' frustrations$_{a}$	-.16	-.17	-.07	**.73**

Note. Subscript next to components indicates expected loadings with "$_{e}$" indicating expressive activity, "$_{a}$" indicating altruistic activity, "$_{p}$" indicating physical activity, and "$_{m}$" indicating meditative activity.

Table 5 Factor Loadings for Single Factor Solution for 13 MAQ Items (N = 70)

Components	Factor
Journaling$_e$	.72
Helping friends and family$_a$	.70
Playing games (video, board, etc..)$_e$	.52
Jogging/Running$_p$	.78
Yoga$_p$	.79
Weight Lifting$_p$	.42
Drawing/Painting$_e$	.64
Meditation$_m$	.41
Formal charity work$_a$	.02
Swimming$_p$	.14
Relaxing (no other activity)$_m$	-.04
Prayer$_m$	.34
Listening to others' frustrations$_a$	-.20

Note. Subscript next to components indicates expected loadings with "$_e$" indicating expressive activity, "$_a$" indicating altruistic activity, "$_p$" indicating physical activity, and "$_m$" indicating meditative activity.

While still not aligning explicitly with the predicted loadings, the 13-item solution for the MAQ does a better job of accounting for unique factors represented within components, explaining 65% of variance. The only exception was the Meditation item. Meditation, like Yoga, is a widely recognized mindfulness activity and is described as the formal practice of mindfulness (Kabat-Zinn, 2005). Because meditation is a quintessential form of mindfulness practice, it may be expected that various subfacets of mindfulness itself are represented within the behavior. As with the Yoga item, the Meditation item was retained due to its widely recognized virtue as a mindfulness practice.

When comparing the four and single factor solutions, it appears that the four item solution does a better job of loading the remaining mindfulness behaviors onto a factor. The single factor solution appears to load a few items very highly, however there are some items

which showed low or negative loadings. This suggests that the four factor solution does a better job of accounting for a variety of approaches toward mindfulness. For this reason, the four factor solution was retained, and going forward, the 13-item MAQ solution will be used. This hypothesis was partially supported.

Hypothesis Three (b): Tests of Reliability

For the MAQ 13-item solution a Bartlett's Test of Sphericity was run. which was used to find common model fit indices. It yielded outcomes for a goodness-of-fit Chi-Square test that was significant $x^2(78) = 313.82$, $p < .001$, demonstrating suitability for factor analysis Tabachnik and Fidell (2007). The Kaiser-Meyer-Olkin measure of sampling adequacy yielded a value of 0.70 suggesting that the data falls within range as appropriate for factor analysis Tabachnik and Fidell (20013). A Spearman Brown coefficient of 0.61 showed acceptable reliability, in support of my hypothesis.

Hypothesis Three (c): Tests of Convergent and Divergent Validity

Correlation values were obtained between total scores on the MAQ and other measures of mindfulness, in addition to measures thought to be uniquely different from mindfulness to gauge convergent and discriminant validity respectively. Please see Table 6 for descriptive and correlation statistics. The MAQ showed non-significant positive associations with the FFMQ and AMPS, while showing a non-significant negative association with the MAAS. The MAQ also showed a non-significant negative association with the MWQ (mind-wandering), and a small significant negative correlation with the PSWQ, $r = -.24$, $p < .05$.

Table 6 Correlations for MAQ Convergent and Discriminate Validity

Variables	*M*	*SD*	1	2	3	4	5
MAQ	69.8	54.45					
MWQ	20.51	6.42	**-.05**				
MAAS	3.21	1.05	**-.14**	-.13			
AMPS_Total	37.77	10.27	**.17**	-.09	.11		
FFMQ_Total	120.23	18.26	**.11**	-.26*	.30*	.52**	
PSWQ	54.39	13.48	**-.24***	.46**	-.07	-.24*	-.42**

Note. MAQ is Mindfulness Activities Questionnaire, MWQ is Mind Wandering Questionnaire, MAAS is Mindfulness Attention Awareness Scale, AMPS is Applied Mindfulness Processes Scale, FFMQ is Five Facets of Mindfulness Questionnaire, PSWQ is Penn State Worry Questionnaire. * indicates weak association, ** indicates moderate association.

Hypothesis Four

The bivariate correlation between MAQ and the PSWQ showed a weak, negative, significant association, $r = -.24$, $p < .05$. All associations between the MAQ and span scores were non-significant; OSpan full trial accuracy, $r = .21$, $p = .09$, SSpan full trial accuracy, $r = .09$, $p = .48$, SSpan efficiency, $r = .20$, $p = .12$, with the exception of a weak, positive, significant association with OSpan efficiency, $r = .24$, $p = .047$. Follow-up analyses were conducted to explore relations between MAQ total scores and secondary span scores for the OSpan and SSpan measures (e.g., proportion correct, number of successes, processing accuracy, processing median response time, max span, and span corr 2-5). Results indicated MAQ total scores were not significantly related to any of the secondary WMC scores, $rs \leq .24$, $ps \geq .053$, with the exception of OSpan correct 5, $r = .36$, $p = < .005$. All Span correct outcomes grew in strength and began

trending toward significance as the number of storage/processing and recall elements increased. For descriptive information of primary and secondary Span outcomes see Table 7.

Table 7 Descriptive Information for Primary and Secondary Span Outcomes

Variables	*M*	*SD*	Skewness	Kurtosis
OSpan accuracy	31.6	13.09	.35	-.82
OSpan proportion correct	.70	.12	-.18	-.47
OSpan number of successes	53.94	10.30	.03	-.65
OSpan processing accuracy	.92	.07	-1.49	2.78
OSpan efficiency	.02	.01	.64	-.54
OSpan processing median response time	2269.18	718.59	.80	.15
OSpan max span	4.04	.80	-.08	-1.43
OSpan 2 correct	5.31	1.11	-2.40	7.63
OSpan 3 correct	3.96	1.58	-.40	-.60
OSpan 4 correct	1.69	1.73	.83	-.39
OSpan 5 correct	.47	.76	1.66	2.31
SSpan accuracy	50.98	18.66	-.54	-.18
SSpan proportion correct	.83	.15	-1.68	2.48
SSpan number of successes	67.11	13.61	-1.58	2.31
SSpan processing accuracy	.94	.14	-2.65	5.55
SSpan efficiency	.05	.03	.23	-.78
SSpan processing median response time	1171.83	357.2	1.33	2.71
SSpan max span	4.72	.62	-2.10	3.10
SSpan 2 correct	5.36	.98	-1.72	2.86
SSpan 3 correct	4.75	1.66	-1.30	.51
SSpan 4 correct	3.59	1.78	-.56	-.52
SSpan 5 correct	2.33	1.79	.39	-.86

Hypothesis Five

Hierarchical multiple regressions were conducted to determine if OSpan and SSpan scores each explained similar unique variance in the FFMQ while controlling for PSWQ scores.

Two regressions were run with span full trial accuracy scores and span efficiency scores entered into Step 1 of each regression respectively, while worry was entered in Step 2. Results at Step 2 indicated that the overall model predicting FFMQ scores with full trial accuracy scores was significant $F(3, 58) = 4.27$, $p < .01$, $R^2 = .20$, with the predictors together explaining 20% of variance. Both the OSpan, $\beta = -.09$, $SE = .18$, $t(58) = -.69$, $p = .49$, $sr^2 = .01$, and the SSpan, $\beta = -.11$, $SE = .12$, $t(58) = -.90$, $p = .37$, $sr^2 = .01$, failed to explain any significantly unique variance in FFMQ scores, with the PSWQ $\beta = -.43$, $SE = .16$, $t(58) = -3.59$, $p < .01$ $sr^2 = .17$, being the only significantly unique predictor explaining 17% of variance. See Table 7.

Table 8 Hierarchical Regression: Span Full Trial Accuracy and FFMQ

Variable	β	*t*	sr^2	*R*	R^2	ΔR^2	*p*
Step 1				.13	.02	.02	.59
OSpan full trial accuracy	-.10	-.71	.01				.48
SSpan full trial accuracy	-.06	-.46	.004				.65
Step 2				.44	.20	.18	**.005**
OSpan full trial accuracy	-.09	-.69	.01				.49
SSpan full trial accuracy	-.11	-.90	.01				.37
PSWQ	-.43	-3.59	.18				**<.001**

Note. $N = 62$

The next regression using span efficiency scores revealed at Step 2 that the overall model predicting FFMQ scores was significant, $F(3, 58) = 4.81$, $p < .01$, $R^2 = .20$, with the predictors together explaining 20% of variance. Both the OSpan, $\beta = -.11$, $SE = 288.79$, $t(58) = -.88$, $p =$

.38, sr^2 = .02, and the SSpan, β = -.09, *SE* = 93.46, *t*(58) = -.71, *p* = .48, sr^2 = .01, failed to explain any significantly unique variance in FFMQ scores. The PSWQ, β = -.43, *SE* = .16, *t*(58) = -3.60, *p* < .01 sr^2 = .18, was the only significantly unique predictor, explaining 18% of variance. See Table 9. These outcomes support this hypothesis in that both measures for each span tasked explained similar amounts of variance, supporting a domain general perspective.

Table 9 Hierarchical Regression: Span Efficiency and FFMQ

Variable	β	*t*	sr^2	*R*	R^2	ΔR^2	*p*
Step 1				.14	.02	.02	.55
OSpan efficiency	-.11	-.74	.01				.46
SSpan efficiency	-.06	-.44	.003				.66
Step 2				.45	.20	.18	**.005**
OSpan efficiency	-.11	-.88	.02				.38
SSpan efficiency	-.09	-.71	.01				.48
PSWQ	-.43	-3.6	.18				**<.001**

Note. *N* = 62

Hypothesis Six

Hierarchical multiple regressions were run to determine if OSpan and SSpan scores each explained similar unique variance in the MAQ while controlling for PSWQ scores. Two regressions were run with span full trial accuracy scores and span efficiency scores entered into Step 1 of each regression respectively, while worry was entered in Step 2. Results at Step 2

indicate that the overall model predicting MAQ scores with full trial accuracy span scores was non-significant $F(3, 58) = 2.37$, $p = .08$, $R^2 = .11$.

The next regression using span efficiency scores revealed at Step 2 that the overall model predicting MAQ scores was significant, $F(3, 58) = 3.19$, $p < .05$, $R^2 = .14$, with predictors explaining 14% of variance. Both the OSpan, $\beta = .25$, $SE = 859.80$, $t(58) = 1.87$, $p = .07$ $sr^2 = .06$, and the SSpan, $\beta = .08$, $SE = 278.26$, $t(58) = .56$, $p = .58$, $sr^2 = .04$, failed to explain any significantly unique variance in MAQ scores, with the PSWQ $\beta = -.22$, $SE = .48$, $t(58) = -1.81$, $p = .08$ $sr^2 = .06$, also failing to explain any significant unique variance.

While the model for the MAQ and efficiency span scores was significant, none of the individual slopes were significant. Non-significant slope values support a domain general perspective, also supporting this hypothesis. See Table 10.

Table 10 Hierarchical Regression: Span Efficiency and MAQ-13

Variable	β	*t*	sr^2	*R*	R^2	ΔR^2	*p*
Step 1				.31	.09	.09	.06
OSpan efficiency	.26	1.87	.06				.07
SSpan efficiency	.09	.67	.01				.51
Step 2				.38	.14	.05	.03
OSpan efficiency	.25	1.87	.06				.07
SSpan efficiency	.08	.56	.01				.58
PSWQ	-.22	-1.81	.05				.08

Note. $N = 62$

Exploratory Hypothesis One

Four moderation analyses were run using the steps outlined by Preacher and Hayes (2017). In order to test the moderating influences that the FFMQ may have on the relationship between worry span scores, Model 1 from Hayes' (2012) PROCESS macro was used. The results are presented in Tables 11-14. For each test, the predictorXmoderator interaction was assessed revealing that none of the interactions were significant thereby failing to reject the null hypotheses. It is worth noting, however, that the moderation model including the SSpan full trial accuracy and the FFMQ indicated $R^2 = 0.07$, a small to moderate effect size, while OSpan and SSpan efficiency measures moderated by the FFMQ showed weaker effect sizes at $R^2 = .04$ and $R^2 = .05$, respectively. Lastly, SSpan full trial accuracy showed a small effect size, $R^2 = .01$

Table 11 Moderation Model: Effect of the FFMQ on the PSWQ and OSpan Full Trial Accuracy

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	49.08	47.05	.30	[-44.92, 143.07]
PSWQ	-.14	.80	.86	[-1.73, 1.45]
FFMQ	-.10	.37	.78	[-.83, .63]
PSWQ X FFMQ	.0004	.01	**.96**	[-.01, .01]
Model Statistics	$F(3, 64) = .30$, $p = .83$, $R^2 = .01$			

Table 12 Moderation Model: Effect of FFMQ on the PSWQ and OSpan Efficiency

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	0.06	0.03	0.06	[-.002, .12]
PSWQ	-0.0006	0.001	0.21	[-.002, .0004]
FFMQ	-0.0003	0.0002	0.19	[-.001, .0002]
PSWQ X FFMQ	<.0001	<.0001	0.26	[<.0001, <.0001]
Model Statistics	$F(3, 64) = .78$, $p = .51$, $R^2 = .04$			

Table 13 Moderation Model: Effect of the FFMQ on the PSWQ and SSpan Full Trial Accuracy

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	3.70	65.82	.956	[-127.96, 135.35]
PSWQ	1.19	1.11	.29	[-1.03, 3.41]
FFMQ	.49	.51	.35	[-.54, 1.51]
PSWQ X FFMQ	-.01	.01	**.19**	[-.03, .01]
Model Statistics	$F(3, 64) = 1.41$, $p = .30$, $R^2 = .07$			

Table 14 Moderation Model: Effect of the FFMQ on the PSWQ and SSpan Efficiency

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	.01	.09	.90	[-.17, .20]
PSWQ	.001	.002	.47	[-.002, .004]
FFMQ	.0004	.001	.55	[-.001, .002]
PSWQ X FFMQ	<.0001	<.0001	.35	[<.0001, <.0001]
Model Statistics	$F(3, 60) = .94$, $p = .43$, $R^2 = .05$			

Exploratory Hypothesis Two

Four moderation analyses were run using the steps outlines by Hayes (2012) to test the moderating influences that the MAQ may have on the relationship between worry and span scores, Model 1 from Hayes' (2012) PROCESS macro was used. The results are presented in Tables 15-18. None of the interactions were significant. It is worth noting that the OSpan full trial accuracy $R^2 = .05$, OSpan efficiency $R^2 = .06$, as SSpan efficiency, $R^2 = .04$, all showed small to moderate effect sizes in their respective models. SSpan full trial accuracy, $R^2 = .02$, showed a small effect size.

Table 15 Moderation Model: Effect of the MAQ on the PSWQ and OSpan Full Trial Accuracy

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	34.35	12.19	.01	[9.99, 58.70]
PSWQ	-.12	.22	.59	[-.56, .32]
MAQ	-.03	.13	.82	[-.29, .23]
PSWQ X MAQ	.002	.003	.53	[-.003, .01]
Model Statistics	$F(3, 64) = 1.13$, $p = .34$, $R^2 = .05$			

Table 16 Moderation Model: Effect of the MAQ on the PSWQ and OSpan Efficiency

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	.01	0.008	.10	[-.003, .03]
PSWQ	<.0001	.0001	.98	[-.0003, .0003]
MAQ	<.0001	.0001	.61	[-.0001, .0002]
PSWQ X MAQ	<.0001	<.0001	.95	[<.0001, <.0001]
Model Statistics	$F(3, 64) = 1.33$, $p = .27$, $R^2 = .06$			

Table 17 Moderation Model: Effect of the MAQ on the PSWQ and SSpan Full Trial Accuracy

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	57.21	18.04	0.002	[21.13, 92.28]
PSWQ	-.14	.32	.66	[-.78, .50]
MAQ	.03	.19	.89	[-.36, .41]
PSWQ X MAQ	-.0001	.004	.99	[-.01, .01]
Model Statistics	$F(3, 64) = .38$, $p = .77$, $R^2 = .02$			

Table 18 Moderation Model: Effect of the MAQ on the PSWQ and SSpan Efficiency

Predictor	*b Coeff*	*SE*	*p*	Boot 95% CI
Constant	0.05	0.03	0.04	[.002, .10]
PSWQ	-0.0001	0.0004	0.74	[-.001, .001]
MAQ	0.0001	0.0003	0.82	[-.001, .001]
PSWQ X MAQ	<.0001	<.0001	0.9	[<.0001, <.0001]
Model Statistics	$F(3, 64) = .89$, $p = .45$, $R^2 = .04$			

CHAPTER IV

DISCUSSION

Worry was found to moderately and negatively correlate with trait mindfulness. Looking at the subfacets for the mindfulness questionnaire used, worry was found to have moderate and negative associations with the *acting with awareness, non-judgement of inner experiences,* and *describing* subscales while also having a small and negative association with the *non-reactivity to inner experiences* subfacet. The relationships between trait mindfulness and WMC were nonsignificant; results did not support the hypothesis. The *acting with awareness* subfacet of trait mindfulness showed a small, negative, and significant association with verbal WMC accuracy, which was in the opposite direction as expected. These findings go against what was expected after review of the literature and suggest that there are cases in which mindfulness may not be related to improved WMC performance. Overall, it appears that trait mindfulness and worry do have a negative relationship. That being said, the relationship between WMC and trait mindfulness is unclear, leaving hypothesis one partially supported.

Worry was found to negatively, yet non-significantly relate to WMC scores. Furthermore, there appears to be little distinction in relations between accuracy and efficiency scores. It should be noted that Eysenck's processing efficiency theory specifically proposes that worry would disrupt processing efficiency in the phonological loop (Eysenck & Calvo, 1992). Not only do these results fail to support this theory, but they fail to establish a relationship between worry and WMC in general, leaving the second hypothesis unsupported.

Three hypotheses were generated in an effort to validate the researcher created behavioral mindfulness scale (MAQ). The first hypothesis concerns factor loadings. There were 18 items developed which were anticipated to fall under four subfacets primarily concerned with behavioral intentions, yet aiming to cover all the axioms of mindfulness identified by Shapiro et al. (2006). These subfacets include physical, meditative, expressive, and altruistic activities. This led to four factors being specified for an exploratory factors analysis. Upon looking at the factor loadings, it was found that six items showed high cross loading values on multiple factors. This led to the items serving as a mentor, dancing, reading, playing sports games, and playing with pets being removed. While the Yoga item also showed cross loading concerns, it was retained due to its wide recognition as a mindfulness behavior. After running the exploratory factor analysis with a 13-item solution, the Meditation item showed cross loading concern. That being said, because meditation is the formal practice of mindfulness it was also retained.

Next, the 13-item solution was used to create loadings for a four and single factor structure respectively. When comparing the factor structures it became evident that the Relaxation and Listening to others' frustrations items were loading negatively while the Formal charity work, and Swimming items had very low loadings. Delineating the factor structure does not change outcomes on composite scores for a scale, however the four factor structure did a better job of loading mindfulness activities. The four factor structure for the 13-item solution of the MAQ was retained because the factor structure does not change composite scoring outcomes, and because four factors do a better job of loading mindfulness activities in addition to explaining variance. The 13-item solution now showed acceptable loadings, even if the factors and components did not necessarily align as anticipated.

Physical activities appeared to be well represented, with the Jogging/Running, Yoga, and Weight Lifting items loading together. That being said, Drawing/Painting and Meditation also loaded onto the same factor while Swimming did not. This suggests that the aforementioned factor may not represent physical activities as previously conceptualized. Journaling, Helping friends and family, and Playing games (video, board, etc.) loaded together on their own factor. This could be said to represent the expressive activity subfacet. In addition, Helping friends and family could be argued to be expressive as opposed to altruistic depending on how an individual views the behavior. While it is not clear if this factor explicitly represents expressive activities, it is one of the more well-representative factors of a predicted subfacet. Formal charity work, Swimming, and Relaxing (no other activity) all loaded together. It is unclear what this factor may represent as it is difficult to place a connection between the three items. All three were from different predicted subfacets, leaving this factor as the least defined. Finally, Prayer and Listening to others' frustrations loaded together. While these activities may not be explicitly meditative, the connection between these two items becomes clearer when considering that some participants may not pray just for themselves, but for others as well. From this perspective, the act of prayer may possess more altruistic qualities than previously conceptualized. Overall, while the loadings are largely fit for analyses, the components did not consistently align as predicted leaving hypothesis three (a) unsupported.

Next, reliability for the behavioral mindfulness measure (MAQ-13) was assessed using a chi-square test for model fit, Keiser Meyer Olkin test for sampling adequacy, and Spearman-Brown test for split-half reliability. All outcomes indicated that the scale was fit for analyses, leaving hypothesis three (b) supported.

The final hypothesis concerning psychometrics for the behavioral mindfulness measure investigated convergent and discriminant validity. After looking at correlations between the behavioral mindfulness scale and a few trait mindfulness scales, it was revealed that the relationships, while mostly positive, were non-significant. This is concerning because while trait and behavioral mindfulness could have some distinctions, they should be addressing similar underlying constructs. This outcome brings into question whether the behavioral mindfulness measure actually engages with important themes in mindfulness, or if it does so in a way that is not usually captured by measures of trait mindfulness. This leaves the first part of hypothesis 3(c) unsupported. In an assessment of discriminant validity, the behavioral mindfulness measure was evaluated for associations with worry and mind wandering. Non-significant findings for mind wandering, and a weak, negative, and significant association with worry support discriminant validity in that behavioral mindfulness and mind wandering are represented as unrelated constructs, while worry, which has been shown to have a negative relationship with trait mindfulness, had a similar relationship with behavioral mindfulness. These outcomes suggest that the MAQ could be improved in order to better represent mindfulness. Partial support is offered for hypothesis three (c).

While reiterative from the assessment of discriminant validity, behavioral mindfulness and worry showed a weak negative relationship. This leaves the first part of hypothesis four supported. Next, associations between behavioral mindfulness and WMC were tested revealing only non-significant associations with the exception of a weak and positive relationship with verbal WMC efficiency. Should the MAQ actually represent underlying qualities of mindfulness, this outcome would support improvement in verbal WMC performance as indexed by efficiency, through mindfulness. When looking at secondary measures for WMC, results showed a

moderate, positive, and significant relationship between behavioral mindfulness and WMC performance at five storage/width elements (OSpan corr 5) specifically. This suggests that differences in verbal WMC performance were present were present at the highest cognitive load. It is also worth noting that while non-significant, results for the SSpan showed that strength and significance grew as cognitive load for the WMC task increased similar to the OSpan. Overall these results leave hypothesis four partially supported.

For hypotheses five and six, hierarchical regressions were run to determine if verbal and visuospatial WMC as indexed by accuracy and efficiency, would explain similar amounts of variance in trait mindfulness and behavioral mindfulness when controlling for worry. Results showed that for accuracy and efficiency with trait mindfulness, the models were significant at Step 2 when worry was entered. In both of these cases verbal and visuospatial WMC explained very little difference in trait mindfulness. These outcomes offer support for a domain general perspective, and hypothesis five. Behavioral mindfulness was more unique. Span accuracy outcomes offered little to interpret as no significance was found. That being said, both WMC measures explained little difference in behavioral mindfulness outcomes. Span efficiency however, was different. After viewing each variables contribution to differences explained in behavioral mindfulness, none of them were significant. It is worth noting that verbal efficiency explained a greater difference than the other variables for the first time. These outcomes offer support for hypothesis six because the differences explained by both WMC measures is similar. Even though they are similar and non-significant, verbal efficiency has revealed itself as the most related span outcome to behavioral mindfulness.

Lastly, for exploratory hypotheses one and two, a series of moderation analyses looking at the moderating effects of trait mindfulness and behavioral mindfulness may respectively have

on the relationship between worry and span scores revealed no significant interaction terms between worry and trait or behavioral mindfulness. Model statistics revealed that six of the eight models had moderate effect sizes with the remaining two having small effect sizes. While these outcomes fail to support the hypotheses, the effect sizes suggest the possibility that a lack in significant findings could be the result of a lack of power.

Worry and mindfulness are described by qualities of cognition which differ from each other (i.e. present/past orientation, neutral/negative valence). This has been largely affirmed by investigations of the associations between the two constructs found in the literature and the present study (Evans & Segerstrom, 2011; Kabat-Zinn, 2005). Under attentional control theory Eysneck et al., (2007) it was hypothesized that worry may negatively relate to WM performance via disruption of encoding through the phonological loop. Of the hypotheses proposed, the relationship between trait worry and trait mindfulness, and the domain general perspective on WM (albeit mostly non-significantly related to mindfulness traits or behaviors) were supported, in addition to some psychometric validation of the behavioral mindfulness measure. While not supporting a hypothesis, it is worthwhile to note that behavioral mindfulness and verbal WMC efficiency stood out together (i.e. despite weak or null results their relationship appears unique by comparison to other span outcomes). This suggests that the relationship between the two may not be conclusively descried as weak or non-significant, and warrants further investigation. Additionally, for the moderation analyses, non-significant interactions and small to moderate effect sizes indicate an opportunity to investigate variable relationships with a larger sample size.

Limitations and Future Directions

Use of Trait Scales and WMC Scoring

Failing to find significant relationships between the FFMQ and span scores was unexpected. The FFMQ is a rather well-rounded trait mindfulness measure. Both the FFMQ and MAAS are frequently cited measures, however the MAAS does not represent the attitudinal axiom of mindfulness, whereas the FFMQ represents attitude, attention, and intention evenly by comparison. It is possible that a well-rounded measure of mindfulness would be less likely to find significant relationships with WMC, and that there is a specific axiom, or some other conceptualization of the subdomains of mindfulness with relates to WMC better. Given that Eysenck ascribes disruptions to WM as a result of compromises to attentional control processes, it is possible that a trait mindfulness measure which heavily emphasizes the attention axiom would reveal a significant relationship with span scores. That being said, the *acting with awareness* subfacet of the FFMQ showed a negative relationship with verbal WMC accuracy scores. Since this subfacet characteristically represents attention in a large capacity, it is still unclear if attention is the route through which trait mindfulness may relate to WMC.

Similar outcomes were found in the relationship between worry and WMC, with little distinction found in its relationship with verbal versus visuospatial WMC as well. Scoring and interpretation of working memory tests may contribute to variance in findings related to the construct. Proportion correct scoring was not used as a primary measure in the current study because it tends to correlate highly with accuracy measures, Additionally, it was not used because it is advised to use this scoring method only for participants who show processing accuracy at or above 80% (Unsworth et al., 2009). The majority of participants showed acceptable processing accuracy consistent with the literature Unsworth et al., (2009) however,

given that the current sample was already missing some participant data due to software error, excluding participants for analyses did not seem appropriate. The specific tests used to assess WMC may also play a role. While the OSpan and SSpan are frequently cited measures, they are sometimes described as difficult by participants. Width of storage/processing elements was set to a max of five because it approaches the upper limit of items that can be stored in short-term memory for a normative sample. It is possible that different outcomes in span scores as a result of mindfulness and worry may only present themselves at, or beyond the upper end of cognitive load and task demand. While participant scores decreased as the width of WM trails increased, it is unclear exactly how participants may have attempted to optimize performance. The span correct outcomes only detail accuracy of recall. More nuanced insight toward participant behavior could be gained if processing accuracy and response time were also considered. It may be the case that participants choose to prioritize recall over processing as cognitive load increases In the future, research that looks at the relationships between these variables should consider using multiple span or alternative WM tasks (i.e. Reading Span, *N*-Back, or Raven Progressive Matrices), and should dynamically assess participant performance at a higher cognitive load (i.e. at a width of six or seven storage/processing elements while considering processing).

WM tests are sometimes given in several sets, with participant composite scores derived from cumulative performance. The present study only collected data from one complete set of each WMC exercise after completion of demo trials. The demo exercises were important because exposure is needed in order to perform reliably. It is possible that multiple sets of trials would have served better to index WMC as individual differences may be more likely to present with a greater number of trials, however the present study chose one set of trials due to time restraints and because it is common for WM research to use one set of trials as needed (Conway et al.,

2005; Moran, 2016). One final concern for the use of WM measures, is its application in a group setting. While many researchers run participants in batches, the group setting can cause minor distractions to participants which may interfere with their performance (Conway et al., 2005) Future research should consider running span tasks with more sets of responses factored into composite scores, while keeping the number of participants per session as low as possible.

Mindful Activities Questionnaire

Mindfulness in research is typically measured as a trait. It seems there is little in the literature for gauging mindful behaviors that does not specifically relate to a larger intervention. Seeking to address this gap, the present research encountered challenges in indexing behaviors that operationalize mindfulness.

Identifying Mindful Activities. The first task in developing this scale was to identify measurable mindful behaviors. One challenge was that an activity itself may not make one mindful, but is an outcome of what mindful people do. In addition, less mindful individuals can arguably engage in the same activity. For example, individuals may have several motives for engaging in activities listed on the MAQ, and mind-wandering or other distractions can impact how one experiences various activities. Motives could be considered similar to intentions. The subfacets for the MAQ were designed around intentions, such that physical activities are supposed to be the result of an intention to experience physical strain, or that expressive activities come as a result of an intention to express oneself. Behaving in this way could be considered mindful. That being said, physical strain and self-expression may not be the end goal of a behavior. If someone were to engage in these activities with alternative intentions their

behavior may not be mindful, or it may be mindful in a way that is not captured by the action-intention connection which is presupposed in the MAQ. In seeking to redesign the MAQ, future research should consider anchoring subfacets around quality of cognition (similar to the FFMQ). An example of this would be to have a subfacet(s) where a behavior is qualified as being observant, or non-judgmental, or creative.

Factor Loadings. There were quite a few items which were cross-loading in the MAQ, to the extent that five were removed. While limitations of the predicted factor structure have already been discussed, the removal of these items weakened the presence of some of the expected factor loadings, particularly for meditative activities. Another concern is that the Yoga and Meditation items showed cross-loadings in the 13-item solution. While it stands to reason that yoga and meditation may represent multiple qualities of mindfulness, cross-loading is a concern when attempting to identify factor structures. Future research should consider allowing components to load onto multiple factors. For the MAQ, this may mean acknowledging that meditation should not be expected to represent one subfacet of mindfulness alone.

Assessing Duration and Frequency of Activities. Another cause for consideration is scaling the duration/frequency of an activity. Some activities which are mindful would not reasonably be completed for the same length of time. This perception of "reasonable" amounts of time also varies by person. This is evinced by the presence of a floor effect for the Journaling item, where the majority of participants who journal, do so for less than ten minutes a day Consider the Listening to others' frustrations items, and the Jogging/Running item. Unless one is a parent, works in customer service, or frequents emotionally needy individuals, they are likely

not going to spend much of their time listening to others' frustrations since they do not have and may not feel an obligation to do so. For the Jogging/Running item, this behavior comes with the prerequisite of wanting or having an active lifestyle. In acknowledgment of this, the scale was split into two parts where the second part gave responses on a scaled time frame which was more appropriate for activities that one would likely spend less time on. This concern with reasonable amounts of time represents the largest conceptual issue in developing this scale. Thinking from a utilitarian perspective, an activity may cease to be mindful when opportunity costs meet saturation. After exercising for an hour, it may be more mindful to switch activities rather than continuing to exercise more. This issue suggests that more of a behavior that mindful people do may not make one more mindful or be an indication of greater mindfulness past saturation. There is likely an intersection between frequency and duration for the amount of time spent on the activities where one can maximize the benefits, they get from it while reconciling the time they are investing. This is where individual differences may reveal unique points of saturation. Not only does a "mindful amount of time" depend on the activity, but also the person. This suggests that typical numeric scaling may not be the most effective way to gauge frequency and duration of a behavior as mindful. Future mindfulness activity questionnaires should consider a form of discrete scaling that accounts for activity and individual differences in opportunity cost saturation. An example would be participants responding, "I engage in the aforementioned activity until I feel satisfied", "I engage in the aforementioned activity until I am interrupted", or "I engage in the aforementioned activity for a planned amount of time".

Conclusion

It appears that the relationship between WMC and trait mindfulness and worry is not straightforward. WM is a theoretical system which many researchers have strived to define. While Baddeley (2010) describes WM as the composition of several subsystems, it is often unclear how these subsystems interact, or if they should even be conceptualized as distinct. Domain general theory Conway et al., (2005) proposes that even if these subsystems are distinct, the effects of cognitive stress are experienced in a more uniform fashion across subsystems than Eysenck's attentional control or processing efficiency theory would suggest (Eysneck et al., 2007; Eysneck & Calvo, 1992).

While the present study's results largely support a domain general perspective, results from the MAQ suggest the possibility that mindfulness may be associated with efficiency of verbal thought within the WM system. This is what was hypothesized by Eysneck and Calvo (1992). Mindfulness also has a variety of conceptualizations, some of which compete, and others of which expand upon each other. Kabat-Zinn (2005), who is at the forefront of mindfulness research, describes mindfulness as paying attention; in a particular way, on purpose, and in the present moment. Shapiro (2006) distills the axioms of attention, intention, and attitude from this description. That being said, efforts to quantify the presence of these axioms lead to divergence from Kabat-Zinn's description. Some mindfulness measures forego entire axioms, while others attempt to reinvent them to better qualify mindfulness. This issue is pertinent when it comes to establishing the presence of mindfulness within behaviors as opposed to traits. To summarize, mindfulness and working memory represent theoretical constructs, of which the absolute limits have yet to be tested. More research is needed in order to better understand how awareness of these constructs can be used to promote functional and adaptive behavior.

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APPENDIX A

IRB EXEMPT APPROVAL

THE UNIVERSITY OF TENNESSEE
CHATTANOOGA

Institutional Review Board
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Chattanooga, TN 37403
Phone: (423) 425-5867
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TO: William Farmer **IRB # 22-130**
Dr. Ashley Howell

FROM: David Deardorff, Interim Director of Research Integrity
Dr. Susan Davidson, IRB Committee Chair

DATE: 11/18/22

SUBJECT: IRB #22-130: Testing Relationships Among Mindfulness, Worry, and Working Memory Performance (Mindfulness and Memory)

Thank you for submitting your application for exemption to The University of Tennessee at Chattanooga Institutional Review Board. Your proposal was evaluated in light of the federal regulations that govern the protection of human subjects.

Specifically, 45 CFR 46.104(d) identifies studies that are exempt from IRB oversight. The UTC IRB Chairperson or his/her designee has determined that your proposed project falls within the category described in the following subsection of this policy:

46.104(d)(2)(ii): Research only includes educational tests, surveys, interviews, public observation and any disclosure of responses outside of the research would NOT reasonably place subject at risk

Even though your project is exempt from further IRB review, the research must be conducted according to the proposal submitted to the UTC IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an Application for Changes, Annual Review, or Project Termination/Completion form to the UTC IRB. Please be aware that changes to the research protocol may prevent the research from qualifying for exempt review and require submission of a new IRB application or other materials to the UTC IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the UTC IRB as soon as

APPENDIX B

DEMOGRAPHIC QUESTIONNAIRE

- What is your age? __
- What gender do you identify as? Woman • Man • Transgender or transexual, male to female • Transgender or transexual, female to male • Gender non-conforming • A gender identity not listed here • Prefer not to Answer
- What is your race/ethnicity? (select all that apply) Hispanic/Latino • Black or African American • White or European American • American Indian or Alaska Native • Asian • Native Hawaiian or other Pacific Islander • Race and/or Ethnicity Unknown • Other (please list)
- What is your current GPA? (example, 3.25) __
- What do you anticipate will be your GPA for the current semester only? __
- What is your current academic level in school? (by degree credits, or years attended) Freshman Sophomore Junior Graduate Other

APPENDIX C

PENN STATE WORRY QUESTIONNAIRE (PSWQ)

	Not at all typical of me				Very typical of me
1. If I do not have enough time to do everything, I do not worry about it.	1	2	3	4	5
2. My worries overwhelm me.	1	2	3	4	5
3. I do not tend to worry about things.	1	2	3	4	5
4. Many situations make me worry.	1	2	3	4	5
5. I know I should not worry about things, but I just cannot help it.	1	2	3	4	5
6. When I am under pressure I worry a lot.	1	2	3	4	5
7. I am always worrying about something.	1	2	3	4	5
8. I find it easy to dismiss worrisome thoughts.	1	2	3	4	5
9. As soon as I finish one task, I start to worry about everything else I have to do.	1	2	3	4	5
10. I never worry about anything.	1	2	3	4	5
11. When there is nothing more I can do about a concern, I do not worry about it any more.	1	2	3	4	5
12. I have been a worrier all my life.	1	2	3	4	5
13. I notice that I have been worrying about things.	1	2	3	4	5
14. Once I start worrying, I cannot stop.	1	2	3	4	5
15. I worry all the time.	1	2	3	4	5
16. I worry about projects until they are all done.	1	2	3	4	5

APPENDIX D

FIVE FACETS OF MINDFULNESS QUESTIONNAIRE (FFMQ)

Please rate each of the following statements with the number that best describes *your own opinion* of what is *generally true for you*.		**Never or very rarely true**	**Rarely true**	**Sometimes true**	**Often true**	**Very often or always true**
FFQM 1	When I'm walking, I deliberately notice the sensations of my body moving. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 2	I'm good at finding words to describe my feelings. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 3	I criticize myself for having irrational or inappropriate emotions. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 4	I perceive my feelings and emotions without having to react to them. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 5	When I do things, my mind wanders off and I'm easily distracted. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 6	When I take a shower or bath, I stay alert to the sensations of water on my body. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 7	I can easily put my beliefs, opinions, and expectations into words. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 8	I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 9	I watch my feelings without getting lost in them. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 10	I tell myself I shouldn't be feeling the way I'm feeling. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 11	I notice how foods and drinks affect my thoughts, bodily sensations, and emotions. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 12	It's hard for me to find the words to describe what I'm thinking. (D-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 13	I am easily distracted. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 14	I believe some of my thoughts are abnormal or bad and I shouldn't think that way. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 15	I pay attention to sensations, such as the wind in my hair or sun on my face. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 16	I have trouble thinking of the right words to express how I feel about things. (D-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 17	I make judgments about whether my thoughts are good or bad. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 18	I find it difficult to stay focused on what's happening in the present. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

FFQM 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. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 20	I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 21	In difficult situations, I can pause without immediately reacting. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 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. (D-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 23	It seems I am "running on automatic" without much awareness of what I'm doing. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 24	When I have distressing thoughts or images, I feel calm soon after. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 25	I tell myself that I shouldn't be thinking the way I'm thinking. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 26	I notice the smells and aromas of things. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 27	Even when I'm feeling terribly upset, I can find a way to put it into words. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 28	I rush through activities without being really attentive to them. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 29	When I have distressing thoughts or images, I am able just to notice them without reacting. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 30	I think some of my emotions are bad or inappropriate and I shouldn't feel them. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 31	I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow. (OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 32	My natural tendency is to put my experiences into words. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 33	When I have distressing thoughts or images, I just notice them and let them go. (NR)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 34	I do jobs or tasks automatically without being aware of what I'm doing. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 35	When I have distressing thoughts or images, I judge myself as good or bad depending what the thought or image is about. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 36	I pay attention to how my emotions affect my thoughts and behavior. OBS)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

FFQM 37	I can usually describe how I feel at the moment in considerable detail. (D)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
FFQM 38	I find myself doing things without paying attention. (AA-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
FFQM 39	I disapprove of myself when I have irrational ideas. (NJ-R)	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

APPENDIX E

APPLIED MINDFULNESS PROCESSES SCALE (AMPS)

I used mindfulness practice to…	Never	Rarely	Sometimes	Often	Almost Always
1. Observe my thoughts in a detached manner	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
2. Relax my body when I am tense	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
3. See that my thoughts are not necessarily true	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
4. Enjoy the little things in life more fully	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
5. Calm my emotions when I am upset	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
6. Stop reacting to my negative impulses	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
7. See the positive side of difficult circumstances	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
8. Reduce tension when I am stressed	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
9. Realize that I can grow stronger from difficult circumstances	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
10. Stop my unhelpful reactions to situations	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
11. Be aware of and appreciate pleasant events	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
12. Let go of unpleasant thoughts and feelings	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
13. Realize that my thoughts are not facts	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
14. Notice pleasant things in the face of difficult circumstances	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐
15. See alternate views of a situation	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐

APPENDIX F

MINDFULNESS ACTIVITIES QUESTIONNAIRE (MAQ)

Please indicate how many days during a typical week you might spend on each of these activities

1. (PA) Jogging/Running (0) (1) (2) (3) (4) (5) (6) (7)
2. (PA) Yoga (0) (1) (2) (3) (4) (5) (6) (7)
3. (PA) Weight Lifting (0) (1) (2) (3) (4) (5) (6) (7)
4. (EA) Drawing/Painting (0) (1) (2) (3) (4) (5) (6) (7)
5. (EA) Journaling (0) (1) (2) (3) (4) (5) (6) (7)
6. (AA) Formal charity work (0) (1) (2) (3) (4) (5) (6) (7)
7. (AA) Serving as a mentor (0) (1) (2) (3) (4) (5) (6) (7)
8. (AA) Helping friends and family (0) (1) (2) (3) (4) (5) (6) (7)
9. (EA) Playing games (video, board etc...) (0) (1) (2) (3) (4) (5) (6) (7)
10. (PA) Playing sports games (0) (1) (2) (3) (4) (5) (6) (7)
11. (PA) Swimming (0) (1) (2) (3) (4) (5) (6) (7)

When you do engage in these activities, during a typical day how much time would you spend on these activities? (0) indicates N/A, (1) Indicates ten minutes, (2) indicates 20 minutes, (3) indicates 30 minutes, (4) indicates 45 minutes, (5) indicates one hour, (6) indicates two hours (7) indicates more than two hours.

1. (PA) Jogging/Running (0) (1) (2) (3) (4) (5) (6) (7)
2. (PA) Yoga (0) (1) (2) (3) (4) (5) (6) (7)
3. (PA) Weight Lifting (0) (1) (2) (3) (4) (5) (6) (7)
4. (EA) Drawing/Painting (0) (1) (2) (3) (4) (5) (6) (7)

5. (EA) Journaling (0) (1) (2) (3) (4) (5) (6) (7)
6. (AA) Formal charity work (0) (1) (2) (3) (4) (5) (6) (7)
7. (AA) Serving as a mentor (0) (1) (2) (3) (4) (5) (6) (7)
8. (AA) Helping friends and family (0) (1) (2) (3) (4) (5) (6) (7)
9. (EA) Playing games (video, board etc...) (0) (1) (2) (3) (4) (5) (6) (7)
10. (PA) Playing sports games (0) (1) (2) (3) (4) (5) (6) (7)
11. (PA) Swimming (0) (1) (2) (3) (4) (5) (6) (7)

Please indicate how many days during a typical week you might spend on each of these activities

1. (MA) Meditation (0) (1) (2) (3) (4) (5) (6) (7)
2. (MA) Prayer (0) (1) (2) (3) (4) (5) (6) (7)
3. (MA) Reading (0) (1) (2) (3) (4) (5) (6) (7)
4. (MA) Relaxing (no other activity) (0) (1) (2) (3) (4) (5) (6) (7)
5. (EA) Dancing (0) (1) (2) (3) (4) (5) (6) (7)
6. (AA) Listening to others' frustrations (0) (1) (2) (3) (4) (5) (6) (7)
7. (EA) Playing with pets (0) (1) (2) (3) (4) (5) (6) (7)

When you do engage in these activities, during a typical day how much time would you spend on these activities? (0) indicates N/A, (1) Indicates five minutes, (2) indicates ten minutes, (3) indicates fifteen minutes, (4) indicates 30 minutes, (5) indicates 45 minutes, (6) indicates one hour (7) indicates more than one hour.

1. (MA) Meditation (0) (1) (2) (3) (4) (5) (6) (7)
2. (MA) Prayer (0) (1) (2) (3) (4) (5) (6) (7)
3. (MA) Reading (0) (1) (2) (3) (4) (5) (6) (7)
4. (MA) Relaxing (no other activity) (0) (1) (2) (3) (4) (5) (6) (7)
5. (EA) Dancing (0) (1) (2) (3) (4) (5) (6) (7)
6. (AA) Listening to others' frustrations (0) (1) (2) (3) (4) (5) (6) (7)
7. (EA) Playing with pets (0) (1) (2) (3) (4) (5) (6) (7)

Four different avenues for mindful behavior are present here. These avenues include Physical Activity (PA) which entails prolonged physical exertion which has the potential to center one's attention on the present moment in a non-judgmental manner promoting action with awareness (First Set: 1, 2, 3, 10, 11). Meditative Activity (MA) entails a prolonging of an effortful state whereby one reduces their clutter of thoughts and focuses on thoughts and feelings that arise, without acting upon them beyond acknowledging them (Second Set: 1, 2, 3, 4). Expressive Activity (EA) refers to action whereby one is observing and describing sensations, promoting expressive behavior that is non-judgmental and present oriented and not too physically demanding (First Set: 4, 5, 9, Second Set: 5, 7). Finally, there is Altruistic Activity (AA) which refers to action with awareness particularly toward helping others in a non-judgmental present-oriented manner (First Set: 6, 7, 8, Second Set: 6).

APPENDIX G

GENERALIZED ANXIETY DISORDER 7-ITEM SCALE (GAD-7)

Over the last two weeks, how often have you been bothered by the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid, as if something awful might happen	0	1	2	3

APPENDIX H

ANXIETY SENSITIVITY INDEX (ASI-3)

	very little	a little	some	much	very much
1. It is important not to appear nervous.	0	1	2	3	4
2. When I cannot keep my mind on a task, I worry that I might be going crazy.	0	1	2	3	4
3. It scares me when I feel shaky.	0	1	2	3	4
4. It scares me when I feel faint.	0	1	2	3	4
5. It is important to me to stay in control of my emotions.	0	1	2	3	4
6. It scares me when I my heart beat rapidly.	0	1	2	3	4
7. It embarrasses me when my stomach growls.	0	1	2	3	4
8. It scares me when I am nauseous (sick stomach).	0	1	2	3	4
9. When I notice my heart beating rapidly, I worry that I might be having a heart attack.	0	1	2	3	4
10. It scares me when I become short of breath.	0	1	2	3	4
11. When my stomach is upset, I worry that I might be seriously ill.	0	1	2	3	4
12. It scares me when I am unable to keep my mind on a task.	0	1	2	3	4
13. Other people notice when I feel shaky.	0	1	2	3	4
14. Unusual body sensations scare me.	0	1	2	3	4
15. When I am nervous, I worry that I might be mentally ill.	0	1	2	3	4
16. It scares me when I am nervous.	0	1	2	3	4

APPENDIX I

DEPRESSION, ANXIETY, AND STRESS SCALE (DASS)

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

1	I found myself getting upset by quite trivial things	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I just couldn't seem to get going	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I had a feeling of shakiness (eg, legs going to give way)	0	1	2	3
8	I found it difficult to relax	0	1	2	3
9	I found myself in situations that made me so anxious I was most relieved when they ended	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting upset rather easily	0	1	2	3
12	I felt that I was using a lot of nervous energy	0	1	2	3
13	I felt sad and depressed	0	1	2	3
14	I found myself getting impatient when I was delayed in any way (eg, elevators, traffic lights, being kept waiting)	0	1	2	3
15	I had a feeling of faintness	0	1	2	3
16	I felt that I had lost interest in just about everything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I perspired noticeably (eg, hands sweaty) in the absence of high temperatures or physical exertion	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life wasn't worthwhile	0	1	2	3

Reminder of rating scale:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

22	I found it hard to wind down	0	1	2	3
23	I had difficulty in swallowing	0	1	2	3
24	I couldn't seem to get any enjoyment out of the things I did	0	1	2	3
25	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
26	I felt down-hearted and blue	0	1	2	3
27	I found that I was very irritable	0	1	2	3
28	I felt I was close to panic	0	1	2	3
29	I found it hard to calm down after something upset me	0	1	2	3
30	I feared that I would be "thrown" by some trivial but unfamiliar task	0	1	2	3
31	I was unable to become enthusiastic about anything	0	1	2	3
32	I found it difficult to tolerate interruptions to what I was doing	0	1	2	3
33	I was in a state of nervous tension	0	1	2	3
34	I felt I was pretty worthless	0	1	2	3
35	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
36	I felt terrified	0	1	2	3
37	I could see nothing in the future to be hopeful about	0	1	2	3
38	I felt that life was meaningless	0	1	2	3
39	I found myself getting agitated	0	1	2	3
40	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
41	I experienced trembling (eg, in the hands)	0	1	2	3
42	I found it difficult to work up the initiative to do things	0	1	2	3

APPENDIX J

MINDFULNESS ATTENTION AWARENESS SCALE (MAAS)

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

1	2	3	4	5	6
almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never

_____ 1. I could be experiencing some emotion and not be conscious of it until some time later.
_____ 2. I break or spill things because of carelessness, not paying attention, or thinking of something else.
_____ 3. I find it difficult to stay focused on what's happening in the present.
_____ 4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.
_____ 5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.
_____ 6. I forget a person's name almost as soon as I've been told it for the first time.
_____ 7. It seems I am "running on automatic," without much awareness of what I'm doing.
_____ 8. I rush through activities without being really attentive to them.
_____ 9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.
_____ 10. I do jobs or tasks automatically, without being aware of what I'm doing.
_____ 11. I find myself listening to someone with one ear, doing something else at the same time.
_____ 12. I drive places on 'automatic pilot' and then wonder why I went there.
_____ 13. I find myself preoccupied with the future or the past.
_____ 14. I find myself doing things without paying attention.
_____ 15. I snack without being aware that I'm eating.

APPENDIX K

MIND WANDERING QUESTIONNAIRE (MWQ)

Please indicate how often you feel that the following statements apply to you with (1) indicating almost never, (2) indicating very infrequently, (3) indicating somewhat infrequently, (4) indicating somewhat frequently, (5) indicating very frequently, and (6) indicating almost always.

1. I have difficulty maintaining focus on simple or repetitive work

(1) (2) (3) (4) (5) (6)

2. While reading, I find I haven't been thinking about the text and must therefore read it again

(1) (2) (3) (4) (5) (6)

3. I do things without paying full attention

(1) (2) (3) (4) (5) (6)

4. I find myself listening with one ear, thinking about something else at the same time

(1) (2) (3) (4) (5) (6)

5. I mind-wander during lectures or presentations

(1) (2) (3) (4) (5) (6)

VITA

William Farmer was born in Atlanta, GA, to the parents of John and Laurie Farmer. He attended Peoples Elementary and continued to Starr's Mill High School in Fayetteville, Georgia. After graduation, attended Georgia College & State University where he became interested in cognitive science. William worked in the Social Psychology and Wellness lab which prompted him to continue his education in research. He completed the Bachelors of Science degree in May 2020 in Psychology. Afterwards, William attended the University of Tennessee at Chattanooga in the Psychological Science program. During the spring of 2021 William was in a car accident resulting in the amputation of his left arm. He returned to his studies and graduated with a Masters of Science degree in August of 2023. William is now pursuing a career in industry as a data analyst.