Distribution Statement

Distribution A: Public Release.

The views presented here are those of the author and are not to be construed as official or reflecting the views of the Uniformed Services University of the Health Sciences, the Department of Defense or the U.S. Government.

ASSOCIATIONS BETWEEN MINDFULNESS, ANXIETY, AND ACADEMIC PERFORMANCE AMONG ACTIVE-DUTY MEDICAL STUDENTS

by

Kade Thornton, B.S.

Thesis submitted to the faculty of the
Department of Medical and Clinical Psychology
Uniformed Services University of the Health Sciences
In partial fulfillment of the requirements for the degree of
Master of Science, 2021

UNIFORMED SERVICES UNIVERSITY, SCHOOL OF MEDICINE GRADUATE PROGRAMS
Graduate Education Office (A 1045), 4301 Jones Bridge Road, Bethesda, MD 20814

August 18, 2021

APPROVAL SHEET

Title of Dissertation: "Associations Between Mindfulness, Anxiety, and Academic Performance Among Active-Duty Medical Students"

Name of Candidate: Kade Thornton
Master of Science in Medical and Clinical Psychology
August 18, 2021

THESIS AND ABSTRACT APPROVED:

DATE:

LANDOLL.RYAN.R.1406748851 Digitally signed by LANDOLL.RYAN.R.1406748851 Date: 2021.09.07 21:38:03 -04'00' — 7 Sept 21

Dr. Ryan Landoll, Ph.D.
DEPARTMENT OF FAMILY MEDICINE
Committee Chairperson

Raymond McClenen, PsyD Digitally signed by Raymond McClenen, PsyD Date: 2021.09.08 17:36:41 -04'00'

Dr. Raymond McClenen, Psy.D.
DEPARTMENT OF MEDICAL & CLINICAL PSYCHOLOGY
Thesis Advisor

BENNION.LAYNE.D.1157698423 Digitally signed by BENNION.LAYNE.D.1157698423 Date: 2021.09.08 07:44:30 -04'00'

Dr. Layne Bennion, Ph.D.
DEPARTMENT OF MEDICAL & CLINICAL PSYCHOLOGY
Committee Member

COPYRIGHT STATEMENT

The author hereby certifies that the use of any copyrighted material in the thesis manuscript entitled: "Associations Between Mindfulness, Anxiety, and Academic Performance Among Active-Duty Medical Students" is appropriately acknowledged and, beyond brief excerpts, is with the permission of the copyright owner.

Signature 

Kade Thornton, B.S.
Medical and Clinical Psychology
Uniformed Services University
August 18, 2021

ABSTRACT

Title of Thesis: "Associations Between Mindfulness, Anxiety, and Academic Performance Among Active-Duty Medical Students"

Kade Thornton, B.S., 2021

Thesis directed by: Raymond McClenen, Psy.D., Director of Military Psychology Studies, Department of Medical and Clinical Psychology

Medical students face a barrage of cognitively demanding examinations with serious career implications. Anxiety and mindfulness have both been linked to cognitive performance more broadly; however, little is known about their impact among high performers. Participants' (n=35) academic performance was tracked after completion of a baseline assessment. As hypothesized, a moderate negative relationship between dispositional mindfulness and test anxiety (r= -.56) was found. Additionally, mindfulness and test anxiety were both independent predictors of student's scores across four National Board of Medical Examiners (NBME) exams. As predicted, students who reported greater levels of mindfulness scored higher (p=.005, R^2=.20), whereas those reporting higher levels of anxiety scored lower (p=.007, R^2=.22) on average. In contrast to our hypotheses, the interaction between mindfulness and test anxiety was not significant. These preliminary findings suggest mindfulness-based interventions may have an appreciable impact on student performance in addition to helping manage stress and anxiety.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

Standardized testing has become a ubiquitous part of academic life. Students' ability to perform at the next level is gauged when their ACT and SAT scores are used by undergraduate selection committees or when GRE and MCAT scores are used to select prospective graduate and medical students. Upon matriculation to graduate-level programs, even medical students themselves cannot escape hours of standardized testing as they must pass all three steps of the United States Medical Licensing Examination (USMLE) in order to gain medical licensure, and their desire to perform on these exams often leads to anxiety (Beilock & Ramirez, 2011). While cognitive biases associated with anxiety are among the most thoroughly studied and reliable phenomena in the psychological literature (Bar-Haim et al., 2007; MacLeod et al., 2019 Yiend, 2010); we have only recently begun to disentangle anxiety's effects on cognitive functioning within the demands of a performance task. The current study examines the relationship between anxiety and cognitive performance while considering potential mitigating factors. To begin, we will explore the cognitive mechanisms of anxiety, specific test-related anxiety, and the concept of mindfulness – with an emphasis on specific executive functions related to attentional control and emotion regulation – before introducing the burgeoning literature examining their relationship and its role in our current study.

The current cognitive and neuroscience literature has suggested that the attentional network, a crucial mechanism for the achievement of emotion regulatory goals (Viviani, 2013), maybe the most robust neural substrate which links the experience of anxiety to deficits in cognitive performance (Pacheco-Unguetti et al., 2010). Indeed, the direct interaction between the attentional capacity and emotion regulation has been

demonstrated in behavioral (Posner & Rothbart, 1998; Posner & Rothbart, 2000), cognitive (Bradley, 2009; Mathews, 1994; Yiend, 2010), and neuroimaging (Banks et al., 2007; Miyake et al., 2000; Vuilleumier & Huang, 2009; Vuilleumier et al., 2005; Wager et al., 2008) research.

Importantly, our increased understanding of the cognitive mechanisms underlying anxiety has also helped elucidate potential treatment approaches, including cognitive bias modification (Beard, 2011; Jones & Sharp, 2017; MacLeod & Mathews, 2012) and several mindfulness-based interventions (Chen et al., 2012; Edenfield & Saeed, 2012; Hofmann & Gómez, 2017). Mindfulness, in particular, has seen an enormous rise in popularity within the literature and has shown promise in reducing symptoms of both anxiety and depression (Blanck et al., 2018; Hofmann et al., 2010; Vøllestad et al., 2012). Further, cognitive and neuroimaging research suggests the primary cognitive mechanisms underlying the benefits of mindfulness meditation are inhibition and shifting (Holas & Jankowski, 2013; Malinowski, 2008; Moore & Malinowski, 2009) – the same executive function mechanisms of attentional control which are impaired by anxiety.

Based on the current understanding of how anxiety may negatively impact performance during cognitively demanding tasks, such as high-stakes examinations, it seems that mindfulness may serve as a useful alternative approach to managing test anxiety. While we are not aware of any research examining how the interaction between mindfulness and anxiety influences test performance, there is research demonstrating how anxiety (Green et al., 2016; Khalil et al., 2017; Khalil et al., 2019) and mindfulness (Bellinger et al., 2015; Mrazek et al., 2013) impact exam performance independently. Our primary aim is to add to the extant literature by measuring the impact of anxiety,

mindfulness, and their interaction on cognitive performance as measured by average scores across a series of high-stakes examinations taken by medical students.

1.1 Anxiety

From an evolutionary perspective, fear and anxiety serve functional roles. Perhaps chief among them is facilitating the detection of danger in the environment and assisting in an effective response to perceived threats. Consistent with this perspective, most cognitive models define anxiety as an evolutionarily adaptive defensive response to a perceived threat - where sympathetic arousal associated with anxiety may impact physiology, behavior, and cognition (Mathews, 1994; Mogg & Bradley, 1998). In order to gain a more complete understanding of how anxiety is understood within the literature, three key points must be kept in mind. First, these models conceptualize anxiety both as a transient mood state (state anxiety) and as a dimension of personality (trait anxiety) (Eysenck et al., 2007; Mathews, 1994; Mogg & Bradley, 1998). Importantly, this distinction underscores the dimensional nature of anxiety and the basis for our understanding of anxiety as maladaptive. Indeed, while fear and anxiety are, at times, nearly ubiquitous and often adaptive, the vast majority of literature is focused on high trait anxious individuals who show a predisposition to feel greater levels of state anxiety more frequently, exhibit lower thresholds, and respond in a manner that negatively impacts their life and is therefore considered maladaptive (thus is mostly individuals struggling with clinical levels of anxiety). Second, threat, as it is defined in the literature, may refer to either external (i.e., environmental threat) or internal (i.e., worrisome thoughts) stimuli. Finally, from a cognitive perspective, it has been suggested that the attentional system of anxious individuals may be uniquely sensitive to, and biased

toward, threatening information within their environment (Bar-Haim et al., 2007; Eysenck et al., 2007; Yiend, 2010). Indeed, intensive effort has been directed at better understanding attentional biases among both clinically anxious and non-clinical samples reporting high levels of anxiety across a variety of experimental paradigms. Here salient theoretical perspectives within the field are reviewed, and the current state of evidence regarding the role of attentional biases in the onset and maintenance of anxiety is summarized.

1.1.1 Anxiety: Current State of the Evidence

The relationship between anxiety and attentional biases toward threat has remained an important area of research for over three decades and has amassed a wealth of literature suggesting that threat-related biases are a robust and enduring phenomenon. A meta-analysis by Bar-Haim et al. (2007) analyzed the results of 172 studies and underscored the relationship between anxiety and threat-related attentional biases. Their analysis provided substantive evidence that anxious individuals display a moderate bias towards threatening information ($d = 0.45$). Indeed, similar results have been found in more recent systematic reviews analyzing attentional biases among individuals high in trait worry (28 studies) (Goodwin et al., 2017) and child and adolescent populations (38 studies) (Dudeney et al., 2015).

More specifically, several essential conclusions have helped to shape the direction of future research in this area. First, the observation of threat-related biases is robust and enduring, with anxious individuals displaying biases at a much lower threshold than non-anxious individuals (Bar-Haim et al., 2007; Eysenck et al., 2007; Yiend, 2010). Second, the effects of attentional biases appear to be stable across a variety of experimental

conditions - including measures of spatial attention and attention across time – and populations (Bar-Haim et al., 2007; Eysenck et al., 2007; Yiend, 2010). Moreover, the magnitude of biases toward threatening information is similar in high anxious individuals, whether from clinical populations or from non-clinical populations (Bar-Haim et al., 2007). Third, naturalistic and word stimuli tend to produce equivocal effects (Bar-Haim et al., 2007; Dudeney et al., 2015); however, word stimuli appear to elicit stronger biases among high trait worry populations (Goodwin et al., 2017). Finally, while there is evidence to support both biases to threat and difficulty in disengaging from threat among anxious populations, prolonged disengagement has only been observed among clinically anxious samples and appears to exist only at the highest and most maladaptive levels of anxiety (Olatunji et al., 2013; Olatunji et al., 2011).

While it is now well established that groups of people with higher levels of trait anxiety tend to show greater selective attention to threatening information than groups with lower trait anxiety, there are several methodological limitations within this line of research that should be taken into consideration. First, individuals do not display stable attentional biases to threat over time. The poor test-retest reliability of many measures of attentional bias suggests that these effects are probabilistic and may be best suited for revealing group-level descriptors rather than individual characteristics (MacLeod et al., 2019). Although, variation within individuals may be due in part to other factors such as varying levels of arousal at the time participation, threat intensity, and the personal relevance of the threat – all of which are likely to vary within sessions and between assessments (MacLeod et al., 2019). Finally, threat-related biases have been primarily investigated using measures of trait anxiety. Relatively few studies measure or

manipulate levels of state anxiety, and fewer still assess the interaction between state and trait anxiety directly. While future research is needed to address some methodological issues, it is vital to keep these factors in mind when interpreting the current literature.

1.1.2 Cognitive Models of Anxiety

Cognitive models of anxiety have assigned differential roles to biases in attention, memory, and judgment in the etiology and maintenance of anxiety. Early theories emphasized mood-congruent processing (Beck, 1976; Bower, 1981), meaning that when one idea is thought of, other related concepts are activated and are therefore more easily accessible in memory (Bower, 1981). According to this perspective, anxious individuals' schemas show a bias toward threat-relevant stimuli at all stages of information processing. Building on these early models, the two-stage theory (Williams et al., 1988, 1997) distinguished automatic from elaborative processes. According to this model, anxious individuals tend to show biases of attention only in early automatic stages of processing and was also among the first to account for the effects of state and trait anxiety on cognitive processing. Eventually, these early dichotomous explanations gave rise to a more dimensional approach.

The cognitive motivational analysis model, proposed by Mogg and Bradley (1998), offered a dimensional explanation of the impact of state and trait anxiety on the processing of threat-related stimuli. A central concept of this model is the vigilance avoidance hypothesis, which proposes a curvilinear relationship between threat level and attentional bias. Here, all individuals show an initial avoidance of mildly threatening stimuli and an increasingly strong orientation towards threat as perceived threat intensity increases. High trait anxious individuals show a shift in their curve, such that a stronger

orientation to threat is elicited from lower intensity stimuli.

A more recent theoretical account posits a mechanism responsible for anxiety's adverse effects on cognitive performance. Here anxiety is purported to negatively impact cognitive performance by impairing two features of central executive functioning involved in attentional control processes – inhibition and shifting. Attentional control theory (Eysenck et al., 2007) posits that as levels of anxiety increase and attentional resources are redirected, highly anxious individuals will have less processing capacity than less anxious individuals. According to Eysenck et al. (2007), this preferential allocation of attentional resources to threat-relevant stimuli influences attentional performance in several ways. First, anxiety impairs attentional control by increasing stimulus-driven, or bottom-up processing, limiting the resources available for goal-directed, or top-down, processing capacity (Derakshan & Eysenck, 2009; Eysenck et al., 2007). Second, anxiety tends to have a more substantial impact on processing efficiency – or the effort required to complete a task – than on the quality of task performance (Eysenck & Calvo, 1992). Finally, attentional control theory (Eysenck et al., 2007) suggests that attentional impairments increase as levels of anxiety rise such that performance effectiveness is impaired only at higher, more maladaptive levels of anxiety. Evidence in support of attentional control theory has largely been obtained via laboratory tasks; however, when applied to test-related anxiety, as outlined below, we argue that attentional control theory provides the best theoretical account for how worry can undermine academic performance.

1.1.3 Test Anxiety and Attentional Control Theory

Test anxiety is a specific subtype of anxiety that can be broadly defined as

"intrusive anxiety-related behaviors and cognitions elicited by testing stimuli in academic settings" (Szafranski et al., 2012). While our understanding of test anxiety has evolved over the past several decades, one of the earliest and most enduring theoretical accounts of test anxiety, the interference model (Liebert & Morris, 1967), identified two primary components of test anxiety, emotionality (e.g., physiological arousal) and worry, which laid the foundation for our current understanding of cognitive test anxiety. Expanding on this model, Cassady and Johnson (2002) suggested that physiological arousal on its own does not typically hurt performance. Instead, high levels of physiological arousal often trigger worry, where worry rather than arousal alone undermines performance (Cassady & Johnson, 2002). Indeed, adequate physiological arousal is necessary for optimal performance (Mair, Onos, & Hembrook, 2011).

Importantly, while there is a consistent relationship between higher levels of test anxiety and lower levels of performance (Hembree, 1988) – the strength of this relationship varies across different settings and formats. A meta-analysis evaluating 30 years of test anxiety research conducted by von der Embse and colleagues (2018) found the effects of test anxiety differed significantly both across grade level and by the context of the examination. Interestingly, test anxiety had the greatest negative impact on students in middle grades (6^{th} – 8^{th}) and declined as students moved to more advanced grade levels. Moreover, the largest negative relationships between test anxiety and exam performance were found within the context of standardized high-stakes tests such as the ACT or SAT when compared to classroom testing.

Attentional control theory, as outlined above, posits elevated levels of anxiety lead to impairments in executive functions related to attentional control, which in turn

lead to decreased cognitive performance (Eysenck et al., 2007). Notably, executive functioning develops relatively slowly across childhood and adolescence before maturing in early adulthood (De Luca & Leventer, 2008), suggesting that younger students with less executive control are more easily impaired by anxiety in academic settings. Further, attentional control theory states that performance efficiency tends to be affected to a greater extent than performance effectiveness, such that effectiveness is only impacted at the highest and most maladaptive levels of anxiety (Eysenck et al., 2007). Again, in line with previous findings, this suggests that high-stakes examinations resulting in greater levels of anxiety and exams with time constraints are more likely to lead to impaired performance effectiveness. Standardized exams such as the ACT, SAT, GRE, and MCAT which are both high stakes and have considerable time constraints, likely mean higher levels of anxiety in a context where impaired processing efficiency could translate to significant impairments in exam performance.

1.2. Mindfulness

The term mindfulness is broadly associated with a variety of spiritual and cultural practices born out of Buddhist traditions dating back over 2,500 years (Aswathi, 2013; Lutz, Jha, Dunne, & Saron, 2015). More recently, however, mindfulness has gained widespread popularity in the Western empirical literature, as demonstrated by the nearly exponential growth of articles referencing mindfulness or mindfulness-based interventions (Van Dam et al., 2018). Despite, or perhaps due to, its rapid rise in popularity, mindfulness lacks a generally accepted operational definition – with at least a dozen different definitions currently in the literature (Cardaciotto, 2005). Despite these inconsistencies in the literature, most conceptual models and definitions of mindfulness

include several key elements. Mindfulness, in its most simplistic terms, refers to present moment awareness (Bishop et al., 2006; Brown & Ryan, 2003; Kabat-Zinn, 1990). Perhaps the most cited definition defines mindfulness as "awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). Further, mindfulness can be conceptualized both as characteristic of personality (dispositional mindfulness) and as deliberate mindfulness meditation (state mindfulness) (Wheeler et al., 2016).

In many ways, mindfulness training may be conceptualized as attentional training. The two primary forms of training used to teach mindfulness are *samatha,* or focused attention (FA), and *vipassana,* or open monitoring (OM). *Samatha* meditation involves maintaining one's attention on a single object that may be internal (a thought or bodily sensation) or external (a sound or tactile sensation), where the goal of *vipassana* meditation is to observe and be present in the moment while remaining non-judgmental (Lutz et al., 2007, 2008). Although they differ conceptually, both rely heavily on the development of attentional skills (Bishop et al., 2004; Malinowski, 2008; Shapiro, Carlson, & Astin, 2006).

1.2.2 Mindfulness: Current State of the Evidence

Various mindfulness-based interventions have been shown to reduce symptoms of anxiety (Chen et al., 2012; Edenfield & Saeed, 2012; Goyal et al., 2014; Hofmann & Gomez, 2017), depression (Creswell, 2017; Edenfield & Saeed, 2012; Goyal et al., 2014; Hofmann & Gomez, 2017), substance abuse (Creswell, 2017), and chronic pain (Creswell, 2017; Goyal et al., 2014). Similarly, a variety of methodological approaches

have demonstrated that mindfulness training impacts cognitive functioning: reduces mind wandering (Hasenkamp et al., 2012), increases sustained attention (Moore & Malinowski, 2009; Pagnoni & Cekic, 2007; Schmertz et al., 2009), increases an individual's ability to exert attentional control and inhibit irrelevant stimuli (Chan & Woollacott, 2007; Teper & Inzlicht, 2013).

While the extant literature suggests that mindfulness meditation may prove beneficial both in alleviating psychological symptoms and improving cognitive abilities, relatively little is known about the relationship between state and trait mindfulness. In sharp contrast to the anxiety literature, the vast majority of publications investigating mindfulness use using brief intervention procedures and often fail to account for dispositional abilities beyond controlling for individuals with extensive meditative experience. There is some evidence suggesting that dispositional mindfulness may be inversely related to symptoms of anxiety, depression and may be positively associated with cognitive processes leading to less rumination and catastrophizing (Tomlinson et al., 2018).

1.2.1 Cognitive Models of Mindfulness

Conceptualizations of mindfulness imply that executive functions and attentional processes play a fundamental role in achieving and maintaining a state of mindfulness. Several cognitive models of mindfulness have recently been developed (Holas & Jankowski, 2013; Isbel & Summers, 2017; Jankowski & Holas, 2014). These models each conceive mindfulness in terms of metacognition, or a unique state of self-awareness that is evoked and maintained by specific components of executive function. Importantly these cognitive models also consider that individual differences in mindfulness are due to

a complex interaction between explicit mindfulness training, genetic factors (i.e., general level of executive functioning), and environmental factors shaping personality (Brown, Ryan, & Creswell, 2007). From this perspective, genetic and environmental factors that impact the innate abilities of one's executive function produce differences in levels of dispositional mindfulness. In contrast, the practice of deliberate meditation is viewed as a mechanism by which cognitive mechanisms underlying mindfulness may be strengthened.

In line with previous conceptualizations of executive functioning (Baddeley & Hitch, 1974; Baddeley, 2012; Miyake et al., 2000), Jankowski and Holas (2013) propose that the primary cognitive mechanisms underlying states of mindfulness are inhibition, shifting, information updating, and monitoring. Inhibition and shifting both play crucial roles in modulating attention (Posner & Rothbart, 2007), while information updating and monitoring correspond more closely to models of working memory (Miyake et al., 2000). Each of these components is crucial in evoking a state of mindfulness. More specifically, Jankowski and Holas (2013) suggested that mindfulness depends on two crucial abilities; (1) the ability to inhibit irrelevant information and processes (inhibition), and (2) the ability to switch attention away from distracting information and back to the point of meditative focus (shifting). The ability to notice and disengage from mind-wandering – engaging in task-irrelevant thoughts such as rumination or worry – relies on the strength of these attentional processes. Secondarily, the updating and monitoring functions are proposed to facilitate the ability to both sustain attention on the present moment and ensure that what is represented as present within working memory stores is updated as frequently as possible. Isbel and Summers (2017) suggest a similar model; however, they

propose working memory is the primary mediator by which sustained attention on present-moment experience is regulated.

1.3. Executive Functions

Executive functions, also known as cognitive control processes, broadly act as a set of regulatory mechanisms used to regulate and control behavior. More specifically, executive functions are defined as a set of top-down cognitive processes that adjust thoughts, feelings, and behaviors in order to facilitate goal attainment (Banich, 2009; Friedman & Miyake, 2017; Miyake & Friedman, 2012). While many conceptualizations of executive functions have been proposed, the three most widely studied and empirically supported functions are inhibition, shifting, and updating (Karr et al., 2018; Miyake et al., 2000). Inhibition describes the ability to withhold prepotent responses (impulses) when they are considered to be incompatible with a current goal (Friedman et al., 2016; Miyake & Friedman, 2012; Miyake et al., 2000). Shifting, or task-switching, refers to the ability to shift attention from one task to another (Friedman et al., 2016; Miyake & Friedman, 2012; Miyake et al., 2000). Finally, updating is defined as the ability to monitor the contents of working memory, ensuring that task-relevant information is kept while task-irrelevant information is replaced (Friedman et al., 2016; Miyake & Friedman, 2012; Miyake et al., 2000).

Due to the influence of executive functions in regulating thoughts, feelings, and behaviors, they are considered core cognitive functions and have been shown to influence a wide variety of outcomes and abilities, including academic achievement (Latzman, Elkovitch, Young, & Clark, 2009; St. Clair-Thompson & Gathercole, 2006) and the regulation of ruminative thinking (Hilt, Leitzke, & Pollak; 2014; Whitmer & Gotlib,

2011). Notably, inhibition and shifting - both crucial mechanisms of attentional control – represent the most robust moderating relationship between specific aspects of executive functioning and the achievement of emotion regulatory goals (Viviani, 2013).

1.3.1 Attentional Control and Emotion Regulation

The importance of emotion regulation, in both clinical and neurosciences, has grown as affective instability and low levels of emotional control appear to be common threads across a wide range of psychopathologies. Within the literature, most emotion regulation theorists have adopted a dual-process model (Barrett et al., 2004), wherein emotionally arousing stimuli are processed in bottom-up networks are particularly successful in competing for access to cognitive resources (Vuilleumier et al., 2005; Stanley, Ferneyhough, & Phelps, 2009), requiring strong regulation by top-down processes to maintain cognitive control. This model aligns with attentional control theory in that emotion dysregulation may be understood as arising from increased reactivity to emotional stimuli or from a failure by areas of the prefrontal cortex (PFC) involved in voluntary cognitive control to inhibit irrelevant emotional stimuli (DeRubeis, Siegle, & Hollon, 2008; Phillips, Drevets, Rauch, & Lane, 2003a, 2003b; Posner & Rothbart, 1998).

Evidence gathered from a wide array of behavioral and neuroimaging research has demonstrated that attention plays a critical role in the achievement of emotional regulatory goals. One group of studies investigating the link between attentional capacity and behavioral self-control across different stages of development revealed a link between disruptions to attentional control (ADHD) and emotion dysregulation (behavioral problems) (Posner & Rothbart, 1998; Posner & Rothbart, 2000). A second

line of research has demonstrated that manipulating attentional load may attenuate responses to emotional stimuli (Banich et al., 2009; Compton et al., 2000; Hariri, Bookheimer, & Mazziotta, 2000). Finally, a large number of behavioral studies have documented the effects of attending to emotional stimuli and the existence of emotion-congruent attentional biases in affective disorders (Bradley, 2009; Mathews & MacLeod, 1994; Yiend, 2010), thus highlighting the importance of the interaction between attentional control and emotion regulation.

1.4. The relationship between Mindfulness and Anxiety

While much of the literature regarding anxiety and mindfulness is suggestive of an inverse relationship, an emergent body of literature has begun to explore this link more directly. One theory, the emotion regulatory model (Coffey & Hartman, 2008; Desrosiers et al., 2013), suggests a mediating interaction between mindfulness and anxiety where worry, rumination, and emotion regulation mediate the relationship between mindfulness and psychological distress. This model suggests that mindfulness and anxiety may act in an antagonistic manner where higher levels of mindfulness leads to an attenuation of anxiety symptoms such as worry or, conversely, increases in anxiety may impair mindfulness leading to disruption in emotion regulatory pathways. This theory is bolstered by a growing body of literature, demonstrating an inverse relationship between mindfulness and anxiety. First, two electroencephalographic studies examining late positive potential (LPP) – an objective measure of emotional response – suggest that individuals with high trait mindfulness scores showed smaller LPP amplitudes (Brown et al., 2013) while high trait anxious individuals displayed higher LPP amplitudes (Mocaiber et al., 2009). Second, neuroimaging studies support this inverse relationship

between mindfulness and anxiety. Etkin et al., 2004 demonstrated higher levels of trait anxiety were predictive of elevated activity in the amygdala. Way and colleagues (2010) found that higher levels of trait mindfulness were predictive of lower amygdala activity. In addition to the above literature, Arch and Craske (2010) found that higher trait mindfulness was predictive of lower anxiety after exposure to anxiety-provoking stressors. Similarly, there is evidence that suggests mindfulness-based therapy could alleviate anxiety symptoms via improved emotion regulation (Hofmann et al., 2010; Tang et al., 2015).

Finally, a single study by Jaiswal et al. (2018) has linked cognitive functioning, mindfulness, and anxiety. They found that individuals in a high trait mindfulness and low trait anxiety (HMLA) group were more accurate than those in the low mindfulness and high anxiety (LMHA) group on both the Stroop task and a change detection task, demonstrating a more direct link between mindfulness, anxiety, and executive functioning.

1.4.1 Mindfulness, Anxiety, and Academic Performance in Medical School

Earlier, the ubiquitous nature of standardized testing in graduate health education was presented as an example of the growth of regular assessment of performance. Unfortunately, this emphasis on standardized testing has also been accompanied by high levels of stress, burnout, and anxiety in medicine (Green et al., 2016; Khalil et al., 2017; Khalil et al., 2019). Interventions like mindfulness have been adopted by many medical schools, in fact, 79 percent of medical schools in the United States offer mindfulness-based programming and 30 percent have included mindfulness programming into their curriculum (Barnes et al., 2017). Despite this recognition, there is a relative dearth of

information regarding the impact of anxiety on academic performance and no research that we are aware of directly evaluating the impact of mindfulness on academic performance within medical education. This is a missed opportunity, given the rigorous selection process of graduate studies, the cognitive abilities of medical students are generally high and relatively homogenous (Monroe et al., 2013). Thus, differences in cognitive performance are likely to be influenced by other factors, including potentially anxiety and attentional control. Four studies directly assessing the impact of test anxiety on exam performance were identified - with three finding a small to moderate negative relationship between self-reported test anxiety and USMLE step one scores (Green et al., 2016; Khalil et al., 2017; Khalil et al., 2019), in line with findings at both graduate and undergraduate levels of education more generally (Chapell et al., 2005; Hembree, 1988). Interestingly, while there is a growing body of literature examining the effect of mindfulness-based interventions on stress, anxiety, depression, and burnout among medical students (Daya & Hearn, 2018; De Vibe et al., 2013; Greeson et al., 2015) – we are not aware of any research directly assessing its impact on academic performance. However, there is one study suggesting that mindfulness may improve results on major standardized tests at the graduate level. In examining the effects of mindfulness training on GRE scores, Mrazek et al., (2013) found that when compared to controls, students who had participated in a two-week mindfulness course showed decreases in mind-wandering and increases in verbal comprehension scores on the GRE. While they did not measure student anxiety, these results suggest improvements in attentional control, as shown by reductions in mind-wandering, lead to improvements in performance. Addressing this gap in the literature may provide some initial evidence for a cost-

effective means to not only improve the mental health and well-being of medical students but may also positively impact academic performance.

1.5 Summary & Current Study

The above literature suggests that there is a strong inverse relationship between anxiety and mindfulness that is hydraulic, an increase in one leading to the decrease of the other. Further, these two traits strongly influence attentional networks, which are a vital aspect of emotion regulation and cognitive performance. Within the extant literature examining how anxiety and mindfulness influence cognitive performance, these traits are typically studied individually. Indeed, only a few studies have directly investigated the interaction between anxiety and mindfulness in the context of cognitive performance. The current study aims to build a more thorough understanding of the interactive effects of anxiety and mindfulness on cognitive performance. Given the highly taxing nature of graduate-level standardized testing, both cognitively and emotionally, this study is designed to gauge the practical significance of how these traits impact cognitive performance. A group of elite learners (matriculated into medical school based on their academic history) who all share well above average learning abilities and academic prowess were selected. While this limits generalizability to other populations, a sample with relatively homogenous academic abilities enables increased focus on the variables of interest and potentially decreases the impact of other variables known to impact academic performance (e.g., intellect and cognitive ability). Gaining a better understanding of how individual traits, which may be targeted for change, influence performance on high stakes academic testing may help inform to best help students prepare and may even help predict which students could benefit the most from specific interventions.

1.5.1 Aims and Hypotheses

1.5.1.1. Specific Aim 1. To examine the relationship between test anxiety and performance in high-stakes academic testing.

1.5.1.1.1 Hypothesis 1a. Individuals with the highest levels of test anxiety will display lower test scores when compared to individuals with moderate and low levels of test anxiety.

1.5.1.1.2 Hypothesis 1b. Individuals with the lowest levels of test anxiety will display higher test scores compared to individuals with moderate and high levels of test anxiety.

1.5.1.2 Specific Aim 2. To examine the relationship between trait mindfulness and performance in high-stakes academic testing.

1.5.1.2.1 Hypothesis 2a. Individuals with the highest levels of trait mindfulness will display higher test scores when compared to individuals with moderate and low levels of trait mindfulness.

1.5.1.2.2 Hypothesis 2b. Individuals with the lowest levels of trait mindfulness will display lower test scores compared to individuals with moderate and high levels of trait mindfulness.

1.5.1.3 Specific Aim 3. To examine the relationship between dispositional mindfulness and test anxiety.

1.5.1.3.1 Hypothesis 3a. Due to the inverse relationship between mindfulness and anxiety, we expect there to be a significant inverse relationship between dispositional mindfulness and test anxiety.

1.5.1.4 Specific Aim 4. Investigate the interaction between mindfulness and test

anxiety and their influences on performance in high stakes academic testing

1.5.1.4.1 Hypothesis 4a. The interaction between dispositional mindfulness and test anxiety will better predict academic performance than either trait individually.

1.5.1.4.2 Hypothesis 4b. Individuals with the highest levels of dispositional mindfulness and lowest levels of test anxiety will demonstrate the highest level of performance as determined by the average of four exam scores.

1.5.1.4.3 Hypothesis 4c. Individuals with the lowest levels of dispositional mindfulness and highest levels of test anxiety will demonstrate the lowest level of performance as determined by the average of four exam scores.

CHAPTER 2: METHODS

2.1 Description of Overall Design

The current study used a longitudinal design to investigate how test anxiety and dispositional mindfulness influence performance during high stakes testing as a portion of a more extensive longitudinal study (Pursuing Excellence: Evaluation of an Academic Success Program and Personalized Learning in Undergraduate Medical Education). Cognitive performance was measured via students' average scores from exams taken at the end of four pre-clerkship modules. Self-report measures of test anxiety and trait mindfulness were used to assess individual levels of anxiety and mindfulness. Students completed these measures as part of a larger battery during the collection of baseline data.

2.2 Participants and Recruitment

Thirty-five active-duty medical students participated in this study. There were 19 females and 16 males who participated. The average age of the sample was 24, ranging from 22 to 38 years of age. Sixty-five percent were Caucasian, 3% African American, 28% Asian, and 3% Hispanic or Latino. All spoke fluent English, had 20/20 vision either naturally or corrected, and had no difficulty hearing spoken auditory stimuli. All participants were included in the final analysis.

Participants were recruited as part of a more extensive longitudinal study which is currently in progress at the Uniformed Services University of Health Sciences (USUHS) in Bethesda, Maryland. Recruitment was conducted via recruitment emails, flyers posted on campus, and by word of mouth. All participants were active-duty officers in their first year of medical school at USUHS. This study has received IRB approval through the

Uniformed Services University of the Health Sciences.

2.3 Measures

2.3.1 CTAS-2

The Cognitive Test Anxiety Scale – Second Edition (CTAS-2) is a 24-item revised version of the original 27 item scale focused on the cognitive domain of test anxiety (Cassady & Johnson, 2002). The psychometric quality of the instrument has been compared to other measures of test anxiety, including the Reactions to Tests (Sarason, 1984), Test Anxiety Inventory (Spielberger, 1980), and the Revised Test Anxiety Scale (Benson, Moulin-Julian, Schwarzer, Seipp, & El-Zahhar, 1992). The CTAS also has a high level of internal consistency among an undergraduate population (Cronbach's α .91) and has demonstrated concurrent validity in comparison to the Reactions to Tests scale, Test Anxiety Inventory, and Revised Test Anxiety Scale (Cassady & Johnson, 2002). Furlan, Cassady, and Perez (2009) reported that test-retest reliability coefficients ranged between .88 and .94. Responses are given on a 4-point Likert scale ranging from "not at all typical of me" to "very typical of me" (Cassady, 2004). Scores on the CTAS-2 range from 24 – 96, with established cutoff scores consisting of low test anxiety (24 - 43), moderate test anxiety (44 - 66), and high test anxiety (67 and above) (Thomas et al., 2018). While there are no published validity or internal consistency rates for graduate or medical students, Pate et al., (2021) found a moderate relationship between pharmacy students scores on the CTAS-2 and their performance on The North American Pharmacist Licensure Examination (NAPLEX) – a high stakes licensure examination taken by graduate-level pharmacy students – providing initial evidence for its utility among high performing learners.

2.3.2 MAAS

The Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003) is a 15-item scale designed to assess a core characteristic of dispositional mindfulness, open or receptive awareness of and attention to what is taking place in the present moment. The MAAS uses a 6-point Likert scale with total scores ranging from 1 – 6, where higher scores indicate greater levels of dispositional mindfulness. The reported internal consistency coefficients for the scale were 0.82; test-retest reliability was reported at 0.79 over a three to four-week interval (Brown et al., 2011). Palladino and colleagues (2013) reported internal consistency values of .92 among a sample of 275 fourth-year medical students and residents.

2.3.3 Measures of Performance

The pre-clerkship phase of medical education consists of seven organ-system-based modules. Following each module, both faculty and the National Board of Medical Examiners (NBME) exams are administered to students. These exams were key in grading students' performance in each module as well as gauging students' readiness for the United States Medical Licensing Examination (USMLE) step exams (taken during the 3rd year). The average of the four NBME module exams taken over the course of the first year was used as a measure of cognitive performance.

2.4 Procedures

The recruitment of first-year medical students was conducted via listserv emails, flyers posted throughout the campus, and by word of mouth. Those who responded and agreed to the consent forms were considered eligible to participate in the study. Prior to participation, students completed a written informed consent approved by the University

Institutional Review Board. During the informed consent process, participants were informed that in addition to completing the baseline assessment, the research team would also have access to their overall academic performance (e.g., test scores from the curriculum). Following the informed consent process, participants completed a 90-minute non-diagnostic cognitive and psychological assessment, which included standard measures of cognitive abilities, memory, personality, and psychological health. Assessments were conducted by trained research staff members. Original testing procedures were modified to follow current best practices and university guidelines regarding COVID-19 procedures. Specifically, the testing area was disinfected prior to every testing session by a research team member and participant materials were set up in advance to minimize physical contact. Testing was conducted with the examiner and participant sitting across from each at a table approximately six feet long to ensure physical distancing was maintained throughout the session and masks were worn for the duration of the assessment. Finally, participants were screened for current symptoms via email the evening prior to testing and were not scheduled concurrently to minimize contacts and likelihood of contracting COVID-19.

Following completion of the baseline assessment, participants were given the option to participate in a feedback session where the research team member who conducted the assessment reviewed and discussed their results and offered evidence-based learning strategies individualized to the student's assessment scores. All feedback sessions were completed using virtual platforms (e.g., Google Meet or Zoom) due to COVID-19 protocols. During the feedback session, participants completed a second informed consent where they had the option to share their testing data with the Office for

Student Affairs (OSA) and to allow their data to be used in future research conducted by the University.

2.4.1 Risks to Subjects

It was acknowledged that students who chose to take part in this study may have been distressed by the results of their testing. To mitigate any potential distress, all students were reminded that the assessment was non-diagnostic in nature and would not have any impact on their military or academic standing. If students remained concerned, they were encouraged to seek additional support from members of the academic affairs faculty or with counseling center staff; however, this was entirely voluntary.

2.4.2 Data Management

All information collected from participants was stored using the two-lock method. Physical data were placed in a locked file cabinet in a locked laboratory office at USUHS. Information entered for data entry was stored in a password-protected database and on the USUHS secured google drive. To access student's NBME exam scores, research identification numbers (RIN) and participant names were provided to a member of the Office of Student Affairs (OSA) who had access to exam scores but was blinded to our hypothesis and did not have access to study data. Once exam scores were matched with RINs, student's names were deleted from the document by the OSA staff member before being returned to the research staff and added to the deidentified dataset for analysis.

2.5 Data Analytic Plan

2.5.1 Sample size and power analysis

An *a priori* power analysis for multiple linear regression correlation was

conducted using the G*Power program (Faul, Erdfelder, Lang, & Buchner, 2009) with a power value of .80, a medium effect size of $f^2 = .15$, and an alpha level of .05. G*Power analysis indicated that a total sample size of 77 when using three predictor variables. However, due to precautionary measures taken to help slow the spread of COVID-19 on campus - including temporary telework for all staff and students and enhanced cleaning measures (e.g., disinfecting and allowing 24 hours between testing sessions) – we were unable to reach a sufficient sample size over the course of the academic year.

2.5.2 Hypothesis Testing

2.5.2.1 Specific Aim 1. A regression analysis was used to examine the relationship between test anxiety and high-stakes academic performance. It was hypothesized that test anxiety would be significantly and negatively correlated with performance such that individuals with the highest levels of test anxiety would demonstrate lower scores relative to those with moderate or low levels of test anxiety.

2.5.2.2 Specific Aim 2. A regression analysis was used to examine the relationship between dispositional mindfulness and performance in high-stakes academic testing. It was hypothesized that mindfulness would be significantly and positively correlated with performance such that individuals with the highest levels of dispositional mindfulness will demonstrate better scores compared to those with moderate to low levels of dispositional mindfulness.

2.5.2.3 Specific Aim 3. A bivariate correlation analysis was used to examine the relationship between dispositional mindfulness and test anxiety. It was hypothesized that dispositional mindfulness and test anxiety would be

significantly, and inversely, correlated.

2.5.2.4 Specific Aim 4. Multiple regression was used to examine the relationship between the interaction term (dispositional mindfulness x test anxiety) and academic performance as measured by the average of four NBME exams. It was hypothesized that individuals with the highest levels of dispositional mindfulness and lowest levels of test anxiety would demonstrate the best performance, as demonstrated by higher test scores.

CHAPTER 3: RESULTS

A bivariate correlation was conducted to test the hypothesis that there would be a negative relationship between test anxiety and dispositional mindfulness. Results indicated a moderate negative correlation between student's self-reported test anxiety and dispositional mindfulness scores $r(34) = -.56$, $p < .001$. Additionally, linear regression was conducted to examine the hypothesis that test anxiety would be a significant predictor of student's average NBME scores. A significant regression equation indicated a moderate negative relationship $F(1, 34) = 8.29$, $p = .007$, with an R^2 of .20 (See Appendix A, Figure 1). Linear regression was also conducted to examine the hypothesis that dispositional mindfulness would be a significant predictor of student's average NBME scores. A significant regression equation indicated a moderate positive relationship $F(1, 34) = 9.12$, $p = .005$, with an R^2 of .22 (See Appendix A, Figure 2).

Multiple linear regression was conducted to examine the hypothesis that the interaction between test and anxiety and dispositional mindfulness would better predict student's average NBME scores than either test anxiety or dispositional mindfulness independently. A significant regression equation was found, $F(3, 31) = 3.79$, $p = .02$, with an R^2 of .27 (See Table 1). However, test anxiety, dispositional mindfulness, and the interaction between these variables were all non-significant predictors of test scores. Tests to see if data met the assumption of collinearity indicated that multicollinearity was a concern (test anxiety, Tolerance = .031, VIF = 32.16; dispositional mindfulness, Tolerance = .096, VIF = 10.38; test anxiety x mindfulness interaction, Tolerance = .046, VIF = 21.94). The scatterplot of standardized predicted values showed that the data met the assumptions of homogeneity of variance and linearity. Due to multicollinearity, the

regression model was recalculated using centered variables. The recalculated regression model revealed a significant regression equation, $F(3, 31) = 3.79$, $p = .02$, with an R^2 of .27 (See Table 2). While multicollinearity was no longer a concern (test anxiety, Tolerance = .55, VIF = 1.81; dispositional mindfulness, Tolerance = .68, VIF = 1.47; test anxiety x mindfulness interaction, Tolerance = .76, VIF = 1.3), all three predictors remained non-significant.

CHAPTER 4: DISCUSSION

Anxiety and mindfulness have both been shown to influence cognitive performance. While there is a growing body of research demonstrating an inverse relationship between anxiety and mindfulness (Arch & Craske, 2010; Brown et al., 2013; Etkin et al., 2004; Hoffmann et al., 2010; Mocaiber et al., 2009; Tang et al., 2015; Way et al., 2010) very few studies have examined the interactive effects of their relationship on cognitive performance. A single study found that individuals high in trait mindfulness and low in trait anxiety were more accurate on both a Stroop and change detection task compared to individuals high in trait anxiety and low in trait mindfulness (Jaiswal et al., 2018). While promising, these differences were found under laboratory conditions and tell us little about how these traits interact to influence real-world performance. In the present study, we examined if levels of test anxiety and dispositional mindfulness could predict the test scores of a group of high-achieving medical students. There are two important points addressed in the study's design. First, test anxiety as measured by the CTAS-2 focuses primarily on cognitive aspects of anxiety such as worry rather than physiological manifestations (Cassady & Johnson, 2002). This is in line with previous research suggesting that physiological arousal alone is not enough to undermine performance, but rather, physiological arousal triggers worry, which in turn may negatively impact performance (Cassady & Johnson, 2002). Second, the test score used as a dependent variable was an average of four NBME exams taken over the course of the year. In addition to having serious implications on the career trajectories of students, these exams are exceptionally difficult and are taken under timed conditions. These factors are important as attentional control theory posits that anxiety tends to impact

processing efficiency to a greater degree than performance effectiveness (Eysenck et al., 2007). Additionally, the theory posits that cognitive performance is only impacted at higher, more maladaptive levels of anxiety. The implication is that given unlimited time, performance would not be adversely impacted. However, being asked to complete a cognitively demanding task under timed conditions creates a scenario where high levels of anxiety may indeed lead to impaired performance. Thus, NBME scores are well suited to serve as an ecologically valid indication of cognitive performance under stress.

In line with our hypotheses, we found a moderate negative relationship between dispositional mindfulness and test anxiety such that, on average, medical students with higher levels of test anxiety tended to report lower levels of dispositional mindfulness. Additionally, it was found that dispositional mindfulness and test anxiety were both independent predictors of student's average test scores across four NBME exams. As predicted, students with greater levels of dispositional mindfulness tended to display better performance, as demonstrated by higher exam scores compared to those with lower levels of dispositional mindfulness. Similarly, students who reported higher levels of test anxiety tended to have lower average NBME scores compared to those who reported lower levels of test anxiety. However, while the overall regression model including test anxiety, dispositional mindfulness, and the interaction term was significant, all three predictors were non-significant, and this result remained after controlling for multicollinearity. While it is promising that the overall model was significant, we are unable to make more specific inferences regarding the interactive effects of mindfulness and anxiety on cognitive performance.

There are several potential explanations as to why there was not a significant

interaction term despite both mindfulness and anxiety being independently able to predict exam scores. The first potential explanation is that our measures of test anxiety and dispositional mindfulness are best explained in terms of a single shared factor. Indeed, the impact on performance of both mindfulness and anxiety is best explained by their effects on attentional control (Holas & Jankowski, 2013; Malinowski, 2008; Moore & Malinowski, 2009; Pacheo-Unguetti et al., 2010). This shared connection to attentional control was among the primary reasons we predicted mindfulness and anxiety would be inversely correlated. However, the moderate nature of this relationship suggests there are several other factors at play beyond attentional control, making it unlikely this was the primary reason for the non-significant interaction. Second, with only 35 participants, it is likely we had insufficient statistical power to detect effects when all three predictors were added to the model. Indeed, a priori power analyses suggested a minimum of 77 participants was necessary to achieve adequate power.

4.1 Limitations

In addition to the above-mentioned considerations, there are several other methodological limitations to consider when interpreting these results. First, our sample of medical students and active-duty students is highly specific; therefore, it will be challenging to generalize our results to a larger population. Moreover, it is important to note that NBME exam performance does not contain any measure of physiological performance. Thus, these results are specific to high-achieving populations engaged in cognitively demanding tasks that are not incorporated into physically demanding situations. Additionally, there are many factors that contribute to successful performance on high-stakes exams that we were unable to control for in the present study. For

example, the use of evidence-based study strategies has been shown to have a sizeable impact on academic performance among medical students (West & Sadoski, 2011). Furthermore, the university and local communities offer workshops and training in various stress management techniques, including mindfulness training, throughout the year. Thus subjects could have potentially improved their mindfulness abilities after completing the MAAS as a part of baseline data collection. Next, all measures of mindfulness and anxiety were obtained via self-report. Ideally, this data would be accompanied by a physiological measurement or via measures of state anxiety and mindfulness throughout the exam; however, for ethical reasons, we were not able to introduce any measures which may have influenced student performance during the exam. Finally, this study was correlational in nature; thus, we are unable to make causal inferences about the nature of the relationship between mindfulness, anxiety, and cognitive performance. Another notable limitation of the current study was our inability to explore the possibility of gender, racial and ethnic, or cultural differences playing a significant role in either levels of test anxiety or exam performance. A recent meta-analysis found that in 49 studies comparing males and females and seven studies examining Caucasian compared to African American students, both women and African Americans reported significantly higher levels of test anxiety (von der Embse et al., 2018). Moreover, there is some data suggesting that students from underrepresented groups score lower on both the MCAT and USMLE step one exams (Gauer & Jackson, 2018; Williams et al., 2020). A growing body of research has demonstrated that increasing physician diversity is an important tool for reducing health disparities in the United States (Ibrahim, 2019; Marrast et al., 2014; Talamantes et al., 2019) and better

understanding how to bridge these gaps in medical education is essential to creating a more diverse physician workforce.

4.2 Contributions and Future Directions

The current study contributes to the extant literature in several ways. First, these data further support previous findings demonstrating a negative relationship between measures of dispositional anxiety and dispositional mindfulness. On average, study participants who scored high on test anxiety tended to score lower on mindfulness and vice versa, further supporting the hypothesis that the relationship between anxiety and mindfulness is antagonistic in nature. Second, we found that both test anxiety and trait mindfulness were independent predictors of average NBME exam scores. As previously noted, the most robust connection between anxiety and mindfulness is their connection to the attentional network and impact on attentional control. These findings further suggest that facets which impact attentional capacity to a significant degree are likely to influence performance when completing cognitively demanding tasks. Finally, and perhaps most notably, the present study has demonstrated that dispositional mindfulness and anxiety can have substantial impacts on performance even among exceptionally high performing individuals suggesting that interventions designed to target these traits may be of use when trying to improve performance among individuals who have already obtained high levels of skill.

In addition to addressing the above-noted limitations, future research could further these findings in several ways. First, incorporating a physiological measurement connected with mindfulness, anxiety, and attentional control – such as resting-state heart rate variability (HRV) (Thayer et al., 2012; Thayer & Lane, 2000) – would provide

greater confidence in findings than the use of self-report measures alone. Moreover, while using the average of four NBME exams ensured a more stable measure of performance, collecting baseline data in closer proximation to a single targeted exam may reduce the possibility of outside influences, such as mindfulness workshops, impacting performance between the time of data collection and the exam date. Furthermore, while there is ample evidence to suggest mindfulness-based interventions can reduce anxiety (Daya & Hearn, 2018; Hofmann et al., 2010; Vøllestad et al., 2012), and some evidence suggesting they result in improved performance on tasks such as a practice section of the GRE (Mrazek et al., 2013) – future research should investigate whether mindfulness training can lead to meaningful improvements in performance on real-world tasks. Finally, given the relationship between mindfulness, anxiety, and attentional control, the effects of mindfulness interventions on cognitive performance should be compared to other interventions targeting attentional control (Stewart et al., 2021; Tang & Posner, 2009). This would provide an opportunity to test for the impact of mindfulness's unique contributions above and beyond attentional control.

Table 1. *Summary of Simultaneous Regression Analyses for Variables Predicting Average NBME exam scores (N = 35)*

Variable	B	SE β	β
Test Anxiety	-.23	.44	-.46
Mindfulness	2.33	5.53	.21
Test Anxiety x Mindfulness	.026	.115	.16
R^2		.27	
F		3.79*	

Note.$*p$< .05, $**p$ < .01, $***p$ < .001.

Table 2. *Summary of Simultaneous Regression Analyses for Variables Predicting Average NBME exam scores (N = 35)*

Variable	B	SE β	β
Test Anxiety	-.13	.10	-.25
Mindfulness	3.50	2.08	.31
Test Anxiety x Mindfulness	.026	.115	.04
R^2		.27	
F		3.79*	

Note: Test anxiety, mindfulness, and the interaction term were centered at their means.
Note.$*p$< .05, $**p$ < .01, $***p$ < .001.

Figure 1: *Test Anxiety and NBME Exam Scores.*

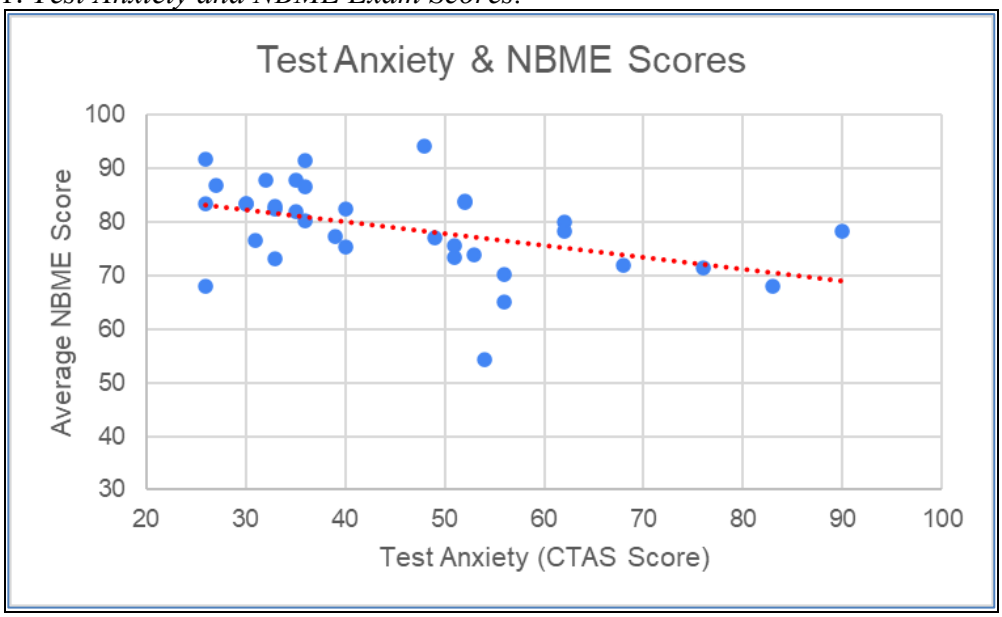
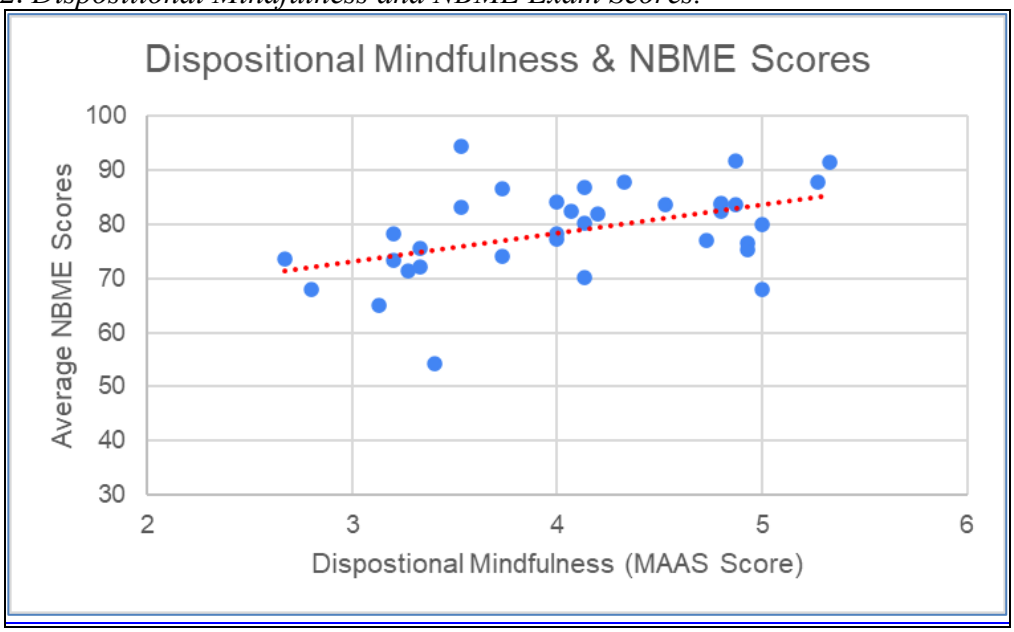


Figure 2: *Dispositional Mindfulness and NBME Exam Scores.*



REFERENCES

Al-Ghareeb, A. Z., Cooper, S. J., & McKenna, L. G. (2017). Anxiety and clinical performance in simulated setting in undergraduate health professionals education: An integrative review. *Clinical Simulation in Nursing*, 13(10), 478-491.

Arch, J. J., & Craske, M. G. (2010). Laboratory stressors in clinically anxious and non-anxious individuals: The moderating role of mindfulness. *Behaviour Research and Therapy*, *48*(6), 495-505.

Arent, S. M., & Landers, D. M. (2003). Arousal, anxiety, and performance: A reexamination of the inverted-U hypothesis. *Research quarterly for exercise and sport*, *74*(4), 436-444.

Awasthi, B. (2013). Issues and perspectives in meditation research: in search for a definition. *Frontiers in psychology*, *3*, 613.

Baddeley, A. (2012). Working memory: Theories, models, and controversies. *Annual review of psychology*, *63*, 1-29.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In *Psychology of learning and motivation* (Vol. 8, pp. 47-89). Academic press.

Banich, M. T. (2009). Executive function: The search for an integrated account. *Current directions in psychological science*, *18*(2), 89-94.

Banks, S. J., Eddy, K. T., Angstadt, M., Nathan, P. J., & Phan, K. L. (2007). Amygdala–frontal connectivity during emotion regulation. *Social Cognitive and Affective Neuroscience*, *2*(4), 303–312.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and non-

anxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*(1), 1–24.

Barnes, N., Hattan, P., Black, D. S., & Schuman-Olivier, Z. (2017). An examination of mindfulness-based programs in US medical schools. *Mindfulness*, *8*(2), 489-494.

Barrett, L. F., Tugade, M. M., & Engle, R. W. (2004). Individual Differences in Working Memory Capacity and Dual-Process Theories of the Mind. *Psychological Bulletin*, *130*(4), 553–573.

Beard, C. (2011). Cognitive bias modification for anxiety: current evidence and future directions. *Expert review of neurotherapeutics*, *11*(2), 299-311.

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders.* New York: International Universities Press.

Beilock, S. L., & Ramirez, G. (2011). Chapter Five - On the Interplay of Emotion and Cognitive Control: Implications for Enhancing Academic Achievement. In J. P. Mestre & B. H. Ross (Eds.), *Psychology of Learning and Motivation* (Vol. 55, pp. 137–169).

Bellinger, D. B., DeCaro, M. S., & Ralston, P. A. (2015). Mindfulness, anxiety, and high-stakes mathematics performance in the laboratory and classroom. *Consciousness and Cognition*, *37*, 123-132.

Benson, J., Moulin-Julian, M., Schwarzer, C., Seipp, B., & El-Zahhar, N. (1992). Cross validation of a revised test anxiety scale using multi-national samples. *Advances in test anxiety research*, *7*, 62-83.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., ... & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical psychology: Science and practice*, *11*(3), 230-241.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., … Devins, G. (2006). Mindfulness: A Proposed Operational Definition. *Clinical Psychology: Science and Practice*, *11*(3), 230–241.

Blanck, P., Perleth, S., Heidenreich, T., Kröger, P., Ditzen, B., Bents, H., & Mander, J. (2018). Effects of mindfulness exercises as stand-alone intervention on symptoms of anxiety and depression: Systematic review and meta-analysis. *Behaviour Research and Therapy*, *102*, 25-35.

Bower, G. H. (1981). Mood and memory. *American psychologist*, *36*(2), 129.

Bradley, M. M. (2009). Natural selective attention: Orienting and emotion. *Psychophysiology*, *46*(1), 1–11.

Brown, K. W., Goodman, R. J., & Inzlicht, M. (2013). Dispositional mindfulness and the attenuation of neural responses to emotional stimuli. *Social Cognitive and Affective Neuroscience*, *8*(1), 93–99.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822–848.

Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological inquiry*, *18*(4), 211-237.

Brown, K. W., West, A. M., Loverich, T. M., & Biegel, G. M. (2011). Assessing adolescent mindfulness: Validation of an Adapted Mindful Attention Awareness Scale in adolescent normative and psychiatric populations. Psychological Assessment, 23(4), 1023–1033.

Cardaciotto, L. (2005). *Assessing mindfulness: The development of a bi-dimensional measure of awareness and acceptance.* Doctoral dissertation, Drexel University, Philadelphia, PA. Retrieved January 31, 2011 from http://hdl.handle.net/1860/547.

Cassady, J. C. (2004). The influence of cognitive test anxiety across the learning–testing cycle. *Learning and instruction*, *14*(6), 569-592.

Cassady, J. C., & Johnson, R. E. (2002). Cognitive Test Anxiety and Academic Performance. *Contemporary Educational Psychology*, *27*(2), 270–295.

Chan, D., & Woollacott, M. (2007). Effects of Level of Meditation Experience on Attentional Focus: Is the Efficiency of Executive or Orientation Networks Improved? *The Journal of Alternative and Complementary Medicine*, *13*(6), 651–658.

Chapell, M. S., Blanding, Z. B., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of educational Psychology*, *97*(2), 268.

Chen, K. W., Berger, C. C., Manheimer, E., Forde, D., Magidson, J., Dachman, L., & Lejuez, C. W. (2012). Meditative therapies for reducing anxiety: A systematic review and meta-analysis of randomized controlled trials. *Depression and anxiety*, *29*(7), 545-562.

Coffey, K. A., & Hartman, M. (2008). Mechanisms of Action in the Inverse Relationship Between Mindfulness and Psychological Distress. *Complementary Health Practice Review*, *13*(2), 79–91.

Compton, R. J., Banich, M. T., Milham, M. P., Heller, W., Miller, G. A., Scalf, P. E., ... & Kramer, A. (2000). Paying attention to emotion: An fMRI investigation. *Journal of Cognitive Neuroscience*, 54-54.

Creswell, J. D. (2017). Mindfulness interventions. *Annual review of psychology*, *68*, 491-516.

Daya, Z., & Hearn, J. H. (2018). Mindfulness interventions in medical education: A systematic review of their impact on medical student stress, depression, fatigue and burnout. *Medical teacher*, *40*(2), 146-153.

De Luca, C. R., & Leventer, R. J. (2008). Developmental trajectories of executive functions across the lifespan.

Derakshan, N., & Eysenck, M. W. (2009). Anxiety, Processing Efficiency, and Cognitive Performance: New Developments from Attentional Control Theory. *European Psychologist*, *14*(2), 168–176.

DeRubeis, R. J., Siegle, G. J., & Hollon, S. D. (2008). Cognitive therapy versus medication for depression: Treatment outcomes and neural mechanisms. *Nature Reviews Neuroscience*, *9*(10), 788–796.

Desrosiers, A., Vine, V., Klemanski, D. H., & Nolen-Hoeksema, S. (2013). Mindfulness and Emotion Regulation in Depression and Anxiety: Common and Distinct Mechanisms of Action. *Depression and Anxiety*, *30*(7), 654–661.

De Vibe, M., Solhaug, I., Tyssen, R., Friborg, O., Rosenvinge, J. H., Sørlie, T., & Bjørndal, A. (2013). Mindfulness training for stress management: a randomised controlled study of medical and psychology students. *BMC medical education*, *13*(1), 1-11.

Dudeney, J., Sharpe, L., & Hunt, C. (2015). Attentional bias towards threatening stimuli in children with anxiety: A meta-analysis. *Clinical Psychology Review*, *40*, 66–75.

Edenfield, T. M., & Saeed, S. A. (2012). An update on mindfulness meditation as a self-help treatment for anxiety and depression. *Psychology research and behavior management*, *5*, 131.

Etkin, A., Klemenhagen, K. C., Dudman, J. T., Rogan, M. T., Hen, R., Kandel, E. R., & Hirsch, J. (2004). Individual Differences in Trait Anxiety Predict the Response of the Basolateral Amygdala to Unconsciously Processed Fearful Faces. *Neuron*, *44*(6), 1043–1055.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and Performance: The Processing Efficiency Theory. *Cognition and Emotion*, *6*(6), 409–434.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, *7*(2), 336–353.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior research methods*, *41*(4), 1149-1160.

Friedman, N. P., & Miyake, A. (2004). The relations among inhibition and interference control functions: a latent-variable analysis. *Journal of experimental psychology: General*, *133*(1), 101.

Friedman, N. P., & Miyake, A. (2017). Unity and diversity of executive functions: Individual differences as a window on cognitive structure. *Cortex*, *86*, 186-204.

Friedman, N. P., Miyake, A., Altamirano, L. J., Corley, R. P., Young, S. E., Rhea, S. A., & Hewitt, J. K. (2016). Stability and change in executive function abilities from

late adolescence to early adulthood: A longitudinal twin study. *Developmental psychology*, *52*(2), 326.

Furlan, L. A., Cassady, J. C., & Pérez, E. R. (2009). Adapting the Cognitive Test Anxiety Scale for use with Argentinean university students. *International Journal of Testing*, *9*(1), 3-19.

Gauer, J. L., & Jackson, J. B. (2018). Relationships of demographic variables to USMLE physician licensing exam scores: a statistical analysis on five years of medical student data. *Advances in medical education and practice*, *9*, 39.

Goodwin, H., Yiend, J., & Hirsch, C. R. (2017). Generalized Anxiety Disorder, worry and attention to threat: A systematic review. *Clinical Psychology Review*, *54*, 107–122.

Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., ... & Ranasinghe, P. D. (2014). Meditation programs for psychological stress and well-being: a systematic review and meta-analysis. *JAMA internal medicine*, *174*(3), 357-368.

Green, M., Angoff, N., & Encandela, J. (2016). Test anxiety and United States medical licensing examination scores. *The clinical teacher*, *13*(2), 142-146.

Greeson, J. M., Toohey, M. J., & Pearce, M. J. (2015). An adapted, four-week mind–body skills group for medical students: reducing stress, increasing mindfulness, and enhancing self-care. *Explore*, *11*(3), 186-192.

Gross, J. J. (Ed.). (2013). *Handbook of emotion regulation*. Guilford publications.

Hariri, A. R., Bookheimer, S. Y., & Mazziotta, J. C. (2000). Modulating emotional responses: Effects of a neocortical network on the limbic system. *NeuroReport*,

11(1), 43.

Hasenkamp, W., Wilson-Mendenhall, C. D., Duncan, E., & Barsalou, L. W. (2012). Mind wandering and attention during focused meditation: A fine-grained temporal analysis of fluctuating cognitive states. *NeuroImage*, *59*(1), 750–760.

Hembree, R. (1988). Correlates, causes, effects, and treatment of test anxiety. *Review of educational research*, *58*(1), 47-77.

Hilt, L. M., Leitzke, B. T., & Pollak, S. D. (2014). Cognitive control and rumination in youth: The importance of emotion. *Journal of experimental psychopathology*, *5*(3), 302-313.

Hofmann, S. G., & Gómez, A. F. (2017). Mindfulness-based interventions for anxiety and depression. *Psychiatric Clinics*, *40*(4), 739-749.

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The Effect of Mindfulness-Based Therapy on Anxiety and Depression: A Meta-Analytic Review. *Journal of Consulting and Clinical Psychology*, *78*(2), 169–183.

Holas, P., & Jankowski, T. (2013). A cognitive perspective on mindfulness. *International Journal of Psychology*, *48*(3), 232-243.

Ibrahim, S. A. (2019). Physician workforce diversity and health equity: it is time for synergy in missions!. *Health equity*, *3*(1), 601-603.

Isbel, B., & Summers, M. J. (2017). Distinguishing the cognitive processes of mindfulness: Developing a standardised mindfulness technique for use in longitudinal randomised control trials. *Consciousness and cognition*, *52*, 75-92.

Jaiswal, S., Tsai, S.-Y., Juan, C.-H., Liang, W.-K., Muggleton, N. G., Muggleton, N. G., & Muggleton, N. G. (2018). Better Cognitive Performance Is Associated With the

Combination of High Trait Mindfulness and Low Trait Anxiety. *Frontiers in Psychology*, *9*.

Jankowski, T., & Holas, P. (2014). Metacognitive model of mindfulness. *Consciousness and cognition*, *28*, 64-80.

Johns, M., Inzlicht, M., & Schmader, T. (2008). Stereotype Threat and Executive Resource Depletion: Examining the Influence of Emotion Regulation. *Journal of Experimental Psychology. General*, *137*(4), 691–705.

Jones, E. B., & Sharpe, L. (2017). Cognitive bias modification: A review of meta-analyses. *Journal of Affective Disorders*, *223*, 175-183.

Kabat-Zinn, J. (1990). Full catastrophe living: The program of the stress reduction clinic at the University of Massachusetts Medical Center.

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: past, present, and future. *Clinical psychology: Science and practice*, *10*(2), 144-156.

Karr, J. E., Areshenkoff, C. N., Rast, P., Hofer, S. M., Iverson, G. L., & Garcia-Barrera, M. A. (2018). The unity and diversity of executive functions: A systematic review and re-analysis of latent variable studies. *Psychological bulletin*, *144*(11), 1147.

Khalil, M. K., Hawkins, H. G., Crespo, L. M., & Buggy, J. (2017). The relationship between Learning and Study Strategies Inventory (LASSI) and academic performance in medical schools. *Medical Science Educator*, *27*(2), 315-320.

Khalil, M. K., Williams, S. E., & Hawkins, H. G. (2019). The use of Learning and Study Strategies Inventory (LASSI) to investigate differences between low vs high academically performing medical students. *Medical Science Educator*, 1-6.

Latzman, R. D., Elkovitch, N., Young, J., & Clark, L. A. (2010). The contribution of

executive functioning to academic achievement among male adolescents. *Journal of Clinical and Experimental Neuropsychology*, *32*(5), 455-462.

Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological reports*, *20*(3), 975-978.

Lutz, A., Dunne, J. D., & Davidson, R. J. (2007). Meditation and the neuroscience of consciousness. *Cambridge handbook of consciousness*, 499-555.

Lutz, A., Jha, A. P., Dunne, J. D., & Saron, C. D. (2015). Investigating the phenomenological matrix of mindfulness-related practices from a neurocognitive perspective. *American Psychologist*, *70*(7), 632-658.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in cognitive sciences*, *12*(4), 163-169.

MacLeod, C., Grafton, B., & Notebaert, L. (2019). Anxiety-Linked Attentional Bias: Is It Reliable? *Annual Review of Clinical Psychology*, *15*(1), 529–554.

MacLeod, C., & Mathews, A. (2012). Cognitive bias modification approaches to anxiety. *Annual review of clinical psychology*, *8*, 189-217.

Mair, R. G., Onos, K. D., & Hembrook, J. R. (2011). Cognitive activation by central thalamic stimulation: the yerkes-dodson law revisited. Dose-response, 9(3), dose-response.

Malinowski, P. (2008). Mindfulness as psychological dimension: Concepts and applications. *The Irish Journal of Psychology*, *29*(1–2), 155–166.

Marrast, L. M., Zallman, L., Woolhandler, S., Bor, D. H., & McCormick, D. (2014). Minority physicians' role in the care of underserved patients: diversifying the

physician workforce may be key in addressing health disparities. *JAMA internal medicine*, *174*(2), 289-291.

Mathews, A. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, *45*(1), 25.

Mathews, A., & MacLeod, C. (1994). Cognitive Approaches to Emotion and Emotional Disorders. *Annual Review of Psychology*, *45*(1), 25–50.

Miyake, A., & Friedman, N. P. (2012). The Nature and Organization of Individual Differences in Executive Functions: Four General Conclusions. *Current Directions in Psychological Science*, *21*(1), 8–14.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The Unity and Diversity of Executive Functions and Their Contributions to Complex "Frontal Lobe" Tasks: A Latent Variable Analysis. *Cognitive Psychology*, *41*(1), 49–100.

Mocaiber, I., Pereira, M. G., Erthal, F. S., Figueira, I., Machado-Pinheiro, W., Cagy, M., … Oliveira, L. de. (2009). Regulation of negative emotions in high trait anxious individuals: An ERP study. *Psychology & Neuroscience*, *2*(2), 211–217.

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy*, *36*(9), 809–848.

Monroe, A., Quinn, E., Samuelson, W., Dunleavy, D. M., & Dowd, K. W. (2013). An overview of the medical school admission process and use of applicant data in decision making: what has changed since the 1980s?. *Academic Medicine*, *88*(5), 672-681.

Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility.

Consciousness and Cognition, *18*(1), 176–186.

Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness Training Improves Working Memory Capacity and GRE Performance While Reducing Mind Wandering. *Psychological Science*, *24*(5), 776–781.

Olatunji, B. O., Armstrong, T., McHugo, M., & Zald, D. H. (2013). Heightened attentional capture by threat in veterans with PTSD. *Journal of Abnormal Psychology*, *122*(2), 397–405.

Olatunji, B. O., Ciesielski, B., & Zald, D. (2011). A selective impairment in attentional disengagement from erotica in obsessive-compulsive disorder. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 35,* 1977–1982.

Pacheco-Unguetti, A. P., Acosta, A., Callejas, A., & Lupiáñez, J. (2010). Attention and Anxiety: Different Attentional Functioning Under State and Trait Anxiety. *Psychological Science*, *21*(2), 298–304.

Pagnoni, G., & Cekic, M. (2007). Age effects on gray matter volume and attentional performance in Zen meditation. *Neurobiology of Aging*, *28*(10), 1623–1627.

Palladino, C. L., Ange, B., Richardson, D. S., Casillas, R., Decker, M., Gillies, R. A., ... & Stepleman, L. (2013). Measuring psychological flexibility in medical students and residents: A psychometric analysis. *Medical Education Online*, *18*(1), 20932.

Pate, A. N., Neely, S., Malcom, D. R., Daugherty, K. K., Zagar, M., & Medina, M. S. (2021). Multisite study assessing the effect of cognitive test anxiety on academic and standardized test performance. *American Journal of Pharmaceutical Education*, *85*(1).

Phillips, M. L., Drevets, W. C., Rauch, S. L., & Lane, R. (2003a). Neurobiology of emotion perception I: The neural basis of normal emotion perception. *Biological Psychiatry*, *54*(5), 504–514.

Phillips, M. L., Drevets, W. C., Rauch, S. L., & Lane, R. (2003b). Neurobiology of emotion perception II: Implications for major psychiatric disorders. *Biological Psychiatry*, *54*(5), 515–528.

Posner, M. I., & Rothbart, M. K. (1998). Attention, self-regulation and consciousness. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *353*(1377), 1915–1927.

Posner, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology*, *12*(3), 427–441.

Posner, M. I., & Rothbart, M. K. (2007). Research on attention networks as a model for the integration of psychological science. *Annu. Rev. Psychol.*, *58*, 1-23.

Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: reactions to tests. *Journal of personality and social psychology*, *46*(4), 929.

Schmertz, S. K., Anderson, P. L., & Robins, D. L. (2009). The Relation Between Self-Report Mindfulness and Performance on Tasks of Sustained Attention. *Journal of Psychopathology and Behavioral Assessment*, *31*(1), 60–66.

Shapiro, S. L., Carlson, L. E., & Astin, J. A. (2006). Mechanisms of Mindfulness. *Journal of Clinical Psychology*, *62*(3), 373–386.

Spielberger, C. D. (1980). *Test Anxiety Inventory (" Test Attitude Inventory")(TAI)*. Consulting Psychologists.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983).

Manual for the state-trait anxiety scale. *Consulting Psychologists*.

Spielberger, C. D., & Spielberger, C. D. (1989). State-trait anxiety inventory: A comprehensive bibliography.

Stanley, D., Ferneyhough, E., & Phelps, E. A. (2009). Neural Perspectives on Emotion: Impact on Perception, Attention, and Memory. *Handbook of Neuroscience for the Behavioral Sciences*.

St Clair-Thompson, H. L., & Gathercole, S. E. (2006). Executive functions and achievements in school: Shifting, updating, inhibition, and working memory. *Quarterly journal of experimental psychology*, *59*(4), 745-759.

Stewart, K. E., Antony, M. M., & Koerner, N. (2021). A randomized experimental analysis of the attention training technique: Effects on worry and relevant processes in individuals with probable generalized anxiety disorder. *Behaviour Research and Therapy*, *141*, 103863.

Szafranski, D. D., Barrera, T. L., & Norton, P. J. (2012). Test anxiety inventory: 30 years later. *Anxiety, Stress & Coping*, *25*(6), 667-677.

Talamantes, E., Henderson, M. C., Fancher, T. L., & Mullan, F. (2019). Closing the gap—making medical school admissions more equitable. *N Engl J Med*, *380*(9), 803-805.

Tang, Y. Y., & Posner, M. I. (2009). Attention training and attention state training. *Trends in cognitive sciences*, *13*(5), 222-227.

Teper, R., & Inzlicht, M. (2013). Meditation, mindfulness and executive control: The importance of emotional acceptance and brain-based performance monitoring. *Social Cognitive and Affective Neuroscience*, *8*(1), 85–92.

Thomas, C. L., Cassady, J. C., & Finch, W. H. (2018). Identifying severity standards on the cognitive test anxiety scale: cut score determination using latent class and cluster analysis. *Journal of Psychoeducational Assessment*, *36*(5), 492-508.

Tomlinson, E. R., Yousaf, O., Vittersø, A. D., & Jones, L. (2018). Dispositional mindfulness and psychological health: a systematic review. *Mindfulness*, *9*(1), 23-43.

Uniformed Services University of Health Sciences. (n.d.). About the School of Medicine: Fact Sheet. Retrieved from https://www.usuhs.edu/medschool/matriculation-facts

Van Dam, N. T., van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., ... & Fox, K. C. (2018). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on psychological science*, *13*(1), 36-61.

Viviani, R. (2013). Emotion regulation, attention to emotion, and the ventral attentional network. *Frontiers in Human Neuroscience*, *7*.

Vøllestad, J., Nielsen, M. B., & Nielsen, G. H. (2012). Mindfulness-and acceptance-based interventions for anxiety disorders: A systematic review and meta-analysis. *British journal of clinical psychology*, *51*(3), 239-260.

von der Embse, N., Jester, D., Roy, D., & Post, J. (2018). Test anxiety effects, predictors, and correlates: A 30-year meta-analytic review. *Journal of affective disorders*, *227*, 483-493.

Vuilleumier, P., & Huang, Y.-M. (2009). Emotional Attention: Uncovering the Mechanisms of Affective Biases in Perception. *Current Directions in Psychological Science*, *18*(3), 148–152.

Vuilleumier, P., Schwartz, S., Duhoux, S., Dolan, R. J., & Driver, J. (2005). Selective Attention Modulates Neural Substrates of Repetition Priming and "Implicit" Visual Memory: Suppressions and Enhancements Revealed by fMRI. *Journal of Cognitive Neuroscience*, *17*(8), 1245–1260.

Wager, T. D., Davidson, M. L., Hughes, B. L., Lindquist, M. A., & Ochsner, K. N. (2008). Prefrontal-Subcortical Pathways Mediating Successful Emotion Regulation. *Neuron*, *59*(6), 1037–1050.

Way, B. M., Creswell, J. D., Eisenberger, N. I., & Lieberman, M. D. (2010). Dispositional mindfulness and depressive symptomatology: Correlations with limbic and self-referential neural activity during rest. *Emotion*, *10*(1), 12.

West, C., & Sadoski, M. (2011). Do study strategies predict academic performance in medical school?. *Medical education*, *45*(7), 696-703.

Wheeler, M. S., Arnkoff, D. B., & Glass, C. R. (2016). What is being studied as mindfulness meditation?. *Nature Reviews Neuroscience*, *17*(1), 59.

Whitmer, A. J., & Gotlib, I. H. (2013). An attentional scope model of rumination. *Psychological Bulletin*, *139*(5), 1036.

Williams, M., Kim, E. J., Pappas, K., Uwemedimo, O., Marrast, L., Pekmezaris, R., & Martinez, J. (2020). The impact of United States Medical Licensing Exam (USMLE) step 1 cutoff scores on recruitment of underrepresented minorities in medicine: A retrospective cross-sectional study. *Health science reports*, *3*(2), e2161.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Matthews, A. (1988). *Cognitive psychology and emotional disorders.* Chichester, England: Wiley.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and emotional disorders* (2nd ed.). Chichester, England: Wiley.

Yiend, J. (2010). The effects of emotion on attention: A review of attentional processing of emotional information. *Cognition and Emotion*, *24*(1), 3–47.