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Ohm … Pardon the Interruption! An Exploration of Mindfulness as a Buffer against the Effects of Intrusions

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An Exploration of Mindfulness as a Buffer against the Effects of Intrusions

by

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DEDICATION

This work is dedicated first and foremost to my amazing parents, Tom and Robyn Fletcher. Without their love, guidance, and support, I would not have been able to accomplish anything that I have. I would also like to dedicate this work to the rest of my family, all of whom have supported me in a variety of ways on my academic journey. As J.K. Rowling states in *Harry Potter and the Order of the Phoenix*, it "makes a difference, having a decent family." I have been blessed to have an amazing family and support system. Thank you all for all of your love and support.

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ABSTRACT

Previous research has provided a helpful, albeit narrow, understanding of task interruptions as related to outcomes such as wellness and performance (e.g., Eyrolle & Cellier, 2000). Building on this foundation by viewing interruptions through the broader theoretical context of the theory of mental workload, this study sought to explain the cognitive processes underlying the negative performance effects often associated with interruptions and to apply an intervention aimed at mitigating these effects. Specifically, mindfulness has emerged as a promising method for reducing the cognitive burden of interruptions. This study examined the effects of intrusions (a type of interruption) on psychological strain and performance through perceived mental workload. Although perceived mental workload did predict strain outcomes, the overall mediation models failed to reach significance. Results also failed to support the hypothesized effect of state mindfulness as a potential moderator. A set of post hoc analyses, however, found that intrusion perceptions acted as a mediator between intrusion condition and psychological strain outcomes. Further, this mediation was moderated by state mindfulness, which in turn was moderated by the intrusion time. Specifically, the indirect effect of intrusion condition on strain outcomes was such that individuals experienced more strain if they received an intrusion compared to those who were not given an intrusion, unless they completed the form quickly and were also low on state mindfulness, in which case there was no difference in strain outcomes based on whether they experienced an intrusion. Together, these results suggest that intrusion *perceptions* play key roles in strain outcomes, and that moderators of these relationships should be further explored.

CHAPTER ONE:

INTRODUCTION

Interruptions in the workplace cost organizations in the United States nearly $600 billion in lost time, annually (Spira & Feintuch, 2005). In high-stakes workplaces, such as hospitals, interruptions can be catastrophic, resulting in more than lost time and revenue. For example, only 20% of medication administrations over a two-year period within one hospital were error free, with interruptions occurring in over 50% of all administrations (Westbrook, Woods, Rob, Dunsmuir, & Day, 2010). In fact, 85% of procedural errors (e.g., failing to read a medication label) and 40% of clinical errors (e.g., administering the wrong dose or drug) were caused by interruptions (Westbrook et al., 2010). Interruptions can be so dangerous, that in the wake of the 1974 deadly Eastern Air Lines Flight 212 crash that killed 75 passengers and crew due to frequent interruptions during the landing process, the Federal Aviation Administration created a mandate that the cockpit must be "sterile" from all non-essential chatter during critical periods (i.e., take-off and landing) to reduce interruptions and distractions (Sumwalt, 1994).

Oftentimes, interruptions during critical points in task execution may be necessary and unavoidable. Physicians, for example, are frequently interrupted in emergency departments or critical care wards—upwards of 20 times per hour (Grundgeiger & Sanderson, 2009). Interruptions are so commonplace across work domains that some have suggested we live in a "culture of interruptions" (Kopomaa, 2007). Given the negative effects on performance, researchers (e.g., Jett & George, 2003; Kopomaa, 2007) argue that it is critical to (1) more fully

understand how interruptions disrupt workflow and (2) investigate ways to mitigate the negative effects of unavoidable interruptions.

I sought to answer this call by first drawing upon the theory of mental workload (e.g., Navon & Gopher, 1979) to explain the previously identified negative relationship between interruptions and psychological strain and performance decrements (e.g., Jett & George, 2003; Magrabi, Li, Day, & Coiera, 2010). Second, I considered a potential intervention that has emerged as a particularly promising method of reducing the threat interruptions pose to well-being and performance: mindfulness. Mindfulness interventions are becoming almost commonplace among organizations. Google recently hired a Chief Happiness Officer that focuses on providing mindfulness interventions for employees (Kovenski, 2014). Companies such as Aetna and Zappos have implemented mindfulness programs with estimated increases in productivity equating to roughly $3,000 annually per employee (Aikens, 2015; Harth, 2014). Additionally, a wealth of research suggests mindfulness is associated with positive outcomes such as decreased stress, anxiety, depressive symptoms, and chronic pain, as well as increased engagement and resilience (Aikens et al., 2014). Thus, the purpose of this study was to provide theoretical grounding to the interruption literature to elucidate why interruptions cause such negative consequences, and then determine whether a mindfulness intervention could mitigate these detrimental effects.

Interruptions

Colloquially, the term ‘interruptions’ is used to describe events that stop primary task completion. Oxford English Dictionary, for example, defines an interruption as “A breaking in upon some action, process, or condition (esp. speech or discourse), so as to cause it (usually temporarily) to cease; hindrance of the course or continuance of something; a breach of

continuity in time; a stoppage" (Oxford English Dictionary, def. 1a). The literature defines interruptions as incidents that hinder or prevent progress on a task (Eyrolle & Cellier, 2000; Jett & George, 2003). At its core, an interruption must (1) capture the attention of an individual and (2) disrupt the current task in some capacity (Eyrolle & Cellier, 2000). It is suggested that an interruption from initiation to completion contains eight discreet, ordered steps: (1) orient to the interrupting task, (2) disengage from the original task, (3) suspend the original task, (4) begin the interrupting task, (5) end the interrupting task, (6) disengage from the interrupting task, (7) orient to the original task, and (8) finally resume the original task (Boehm-Davis & Remington, 2009). Thus, interruptions place additional, generally cognitive, demands on the individual who was disrupted.

These unnecessary or unexpected cognitive demands during task execution make successful outcomes difficult, if not impossible. They can reduce productivity (Magrabi, Li, Day, & Coiera, 2010), increase strain (Jett & George, 2003), and/or lead to errors in task execution (Santell, Hicks, McMeekin, & Cousins, 2003). For example, Eyrolle and Cellier (2000) found that interruptions related to failed attentional monitoring, resulting in human error. Furthermore, the eight steps of an interruption add additional unnecessary time to task completion (e.g., Eyrolle & Cellier, 2000), even when each step is completed with maximal efficiency. This translates into process loss (Steiner, 1966), which can be catastrophic in highly demanding work environments, such as healthcare.

Jett and George (2003) put forth a taxonomy of interruptions, characterizing each type by its origin (i.e., internal/external) and whether it arrests original taskwork (see Table 1). Each of the four types is differentially predictable, and as such, has different costs and benefits to the employee and organization. Below, a more thorough discussion of each type is provided.

Breaks are self-initiated arrestments of progress on a task intended to provide an individual with respite from the task at hand so as to attend to personal needs (Jett & George, 2003). Breaks are seen as beneficial for effective performance, regardless of whether they are planned or spontaneous (Jett & George, 2003). In theory, breaks allow individuals to rejuvenate by redirecting their cognitions to other, less cognitively taxing tasks (Elsbach, 2001) or to nothing in particular (Henning et al., 1997; Jett & George, 2003). Distractions are a type of cognitive reaction to external or internal stimuli or to secondary tasks (Jett & George, 2003). By redirecting cognitive resources away from the primary task and toward the distraction, distractions decrease productivity in the main task (Jett & George, 2003). Discrepancies occur when an individual's expectations of a task and the environment are discordant with reality (Jett & George, 2003). When discrepancies occur, attention toward the task is shifted toward the source of the discrepancy, thereby hindering progress toward completion of the primary task (Jett & George, 2003). Intrusions are unexpected, initiated by an external source, and stop work on the primary task, at least temporarily (Jett & George, 2003).

Interruptions can exist in many forms. However, given that they originate externally and completely arrest task progression, intrusions might arguably be the most detrimental type of interruption, and thus are the focus of this study. Intrusions have been shown to increase fatigue (Lin, Kain, & Fritz, 2013) and frustration (Perlow, 1999), while decreasing self-regulation and perceived performance (Lin et al., 2013). Furthermore, they have specifically been linked to decrements in well-being and performance (e.g., Magrabi, Li, Day, & Coiera, 2010). However, the question yet remains as to *why* intrusions can harm productivity and well-being. The theory of mental workload (e.g., Navon & Gopher, 1979) may provide insight into the mechanisms underlying these negative effects.

Table 1
A Comparison of the Types of Interruptions (Adapted from Jett and George, 2003)

	External origin	**Internal origin**
Completely arrests task	***Intrusion*** Examples include: • Co-workers asking for something • Email that demands attention • Supervisor calling an immediate meeting	***Break*** Examples include: • Taking a lunch break • Checking Facebook • Sitting, doing nothing
Does not arrest task	***Distraction*** Examples include: • Coworkers talking in the hall • Background music playing • Flickering lights	***Discrepancy*** Examples include: • Deadline suddenly changes • File was not located where expected • Task is much harder than expected

Theory of Mental Workload

General workload is defined as the balance between the summation of all resources available to an individual and a summation of all demands placed on an individual by the task (Wickens & Tsang, 2015). Mental workload is an aspect of overall workload and is a primary focus of this study. Mental workload is a multidimensional construct that encompasses individuals' available resources and their allocation efficiency, as well as the demands placed upon them by the task (Navon & Gopher, 1979; Yeh & Wickens, 1988). Essentially, mental workload is the summation of all cognitive demands placed on the individual minus the summation of all cognitive resources available to the individual. If more resources are available to an individual than demanded by the task, he/she has residual resources that can then be mobilized if any unexpected event, such as an intrusion, occurs (Wickens & Tsang, 2015). If

fewer resources are available to the individual than are needed to complete the task, the individual experiences overload (Wickens & Tsang, 2015) which can lead to worsened performance and heightened levels of strain (Fritz & Sonnentag, 2007; Jones, Chonko, Rangarajan, & Roberts, 2007). In other words, when workload is too great, (i.e., demands outweigh resources) an individual experiences overload which is associated with negative outcomes (Jex, 1998; Spector, Dwyer, & Jex, 1988). This is true regardless of the type of workload (i.e., mental, physical, or both).

When considering the overall workload imposed by two separate tasks, it is imperative to consider the types of demands they place on the individual. If, for example, an individual had to ride a bike while also carrying on a conversation with a fellow bike rider, these two separate tasks may not necessarily create excess workload. One task (bike riding) is primarily physical while the other (conversing) is primarily mental, thus creating separate demands that do not overlap. In this instance, the individual would only experience overload if either the bike riding or the conversation reached levels of demand greater than the available resources for that specific task type (Wickens & Tsang, 2015). However, if the demands are similar, thus drawing from the same pool of resources, overload can be experienced even if both demands are still individually below the overload threshold. Take, for example, an assistant professor, working to complete edits on a manuscript due that evening when one of her graduate students interrupts her with an important question regarding an impending grant deadline. Though neither of these tasks are likely to cause overload on their own, the combined drain they place on limited time and cognitive resources can cause overload resulting in poorer quality outcomes (e.g., incomplete, incorrect, or incoherent responses to the student).

The Problem with Intrusions

The theory of mental workload (Navon & Gopher, 1979) implies that intrusions are particularly harmful because they place a greater demand on working memory, thereby reducing the amount of resources that can be directed toward the primary task. Referring back to the eight specific phases of intrusions (Boehm-Davis & Remington, 2009), the periods in which individuals re-orient their attention (e.g., to the intrusion or back to the primary task) are most vulnerable to overload. This is because the individual is executing nearly simultaneous tasks while attempting to disengage one and engage with the other (Boehm-Davis & Remington, 2009). It is during these critical periods, when an individual is still executing one task, while his or her attention is oriented toward a different task, that errors are likely to occur, given the heightened demands in that moment (Navon & Gopher, 1979). Further, it has already been found that intrusions relate to performance decrements on the job (e.g., Monteiro et al., 2015). Therefore, I hypothesize:

(1a) Individuals who experience an intrusion during a primary task will make more errors than those who do not.

In addition to performance decrements, it has been shown that intrusions can be a jarring experience due to their unexpected and uncontrollable nature (e.g. Carton & Aiello, 2009; Eyrolle & Cellier, 2000; Lin, Kain, Fritz, 2013). Stimuli that can neither be controlled nor expected are typically considered stressors, and have often been associated with negative psychological and physical outcomes (e.g., Spector & O'Connell, 1994). Together these negative outcomes of stressors are considered strains (Jackson, 1983). Specifically, strains are the negative reactions or responses to stressors (Jackson, 1983) and are usually categorized and examined depending upon their nature (e.g., psychological, physiological, or behavioral; Myrtek,

Weber, Brügner, & Müller, 1996). For example, perceived stress, a psychological strain, can be considered a high arousal state, marked by tension and a propensity to become upset (Lovibond & Lovibond, 1995). Another psychological strain, anxiety, can be defined as a high arousal state, marked by fear, worry, or nervousness (Lovibond & Lovibond, 1995). Intrusions have previously been associated with a variety of psychological strains (e.g., annoyance and anxiety; Bailey & Konstan, 2006). Yet, Jett and George (2003) specifically point toward "heightened feelings of *stress* and *anxiety*" (p. 496, emphasis added) as likely outcomes of intrusions, thus I hypothesize:

(1b) Individuals who experience an intrusion during a primary task will experience more anxiety than those who do not.

(1c) Individuals who experience an intrusion during a primary task will experience more stress than those who do not.

Furthermore, the theory of mental workload (Navon & Gopher, 1979) argues that when both tasks (the primary task and the intrusion) draw on similar cognitive resources, the coupling effect may result in errors. Specifically, in a cognitively demanding task, once a second demanding task is introduced (e.g., the intrusion), the coupling effect creates a situation where demands exceed resources. This results in the inability to sustain performance across both tasks, and performance suffers (Wickens & Tsang, 2015).

Even after work resumes, intrusions have residual effects such as interrupted flow (Csikszentmihalyi & LeFevre, 1989; Jett & George, 2003), missed or forgotten process steps, and/or effortful return of attention to the primary task. Each of these consequences adds to the demands placed on cognitive resources, thus making it more likely that the individual will experience overload and the negative outcomes thereof (Jex, 1998). As overall demands increase (which is more likely when there is the coupling effect described above), so does perceived

mental workload (Wickens & Tsang, 2015). Similar to the decrease in task performance when overall workload is increased (Fritz & Sonnentag, 2006), task performance should decrease as perceived mental workload increases. Therefore, I hypothesize:

(2a) Perceived mental workload will partially mediate the relationship between an intrusion and the number of errors made.

The theory of mental workload (e.g., Navon & Gopher, 1979) suggests that intrusions act as demands upon limited resources (e.g., time and cognition), particularly in situations where time is already scarce. Furthermore, because intrusions—by definition—originate from an external source and result in a complete and unexpected arrest of progress on the primary task, they embody a lack of control over task progression. This places additional cognitive demands on the worker, increasing perceived mental workload (Wickens & Tsang, 2015), and potentially resulting in overload. Again, similar to the relationship between overall workload and increased strain (Fritz & Sonnentag, 2006; Jex, 1998; Spector, Dwyer, & Jex, 1988), as perceived mental workload increases and edges closer to overload, there should be a corresponding increase in indicators of strain, such as anxiety and stress. These particular strain outcomes have been shown to be sensitive to increased mental workload and demands such as time pressure (e.g., Mark, Gudith, & Klocke, 2008; Maule, Hockey, Bdzola, 2000). Given that in this study time pressure may represent a critical demand, I hypothesize:

(2b) Perceived mental workload will partially mediate the relationship between an intrusion and anxiety.

(2b) Perceived mental workload will partially mediate the relationship between an intrusion and stress.

Buffering Effect of Resources

Explaining how intrusions relate to negative performance outcomes and decreased well-being through the theory of mental workload (Navon & Gopher, 1979) sheds light on potential mechanisms that might mitigate these decrements. Intrusions can be classified as additional, unexpected cognitive demands. Drawing on the notion of demands and resources from the theory of mental workload (Navon & Gopher, 1979), to counter the additional demands, employees need additional resources (Bakker, Demerouti, & Schaufeli, 2003). Wickens and Tsang (2015) suggest that task management strategies—potential resources themselves—can be trained to help minimize drain on the overall pool of limited resources. One particular intervention, mindfulness, may be uniquely capable of mitigating negative effects of intrusions on performance and well-being, particularly when explaining this relationship through the context of increased perceived mental workload.

Mindfulness

Originating in Buddhist teachings, the concept of mindfulness has been defined in a several ways. There are two contemporary and distinct definitions of mindfulness. Langer has created a body of research on mindfulness that focuses more on the openness to possibilities and non-reliance on heuristics. These studies, however, generally rely upon priming a mindful thought process, rather than an actual practice of mindfulness or mindfulness intervention (e.g., Langer, 1989, 1997). A second definition of mindfulness suggests that, at its core, mindfulness is a state of consciousness marked by deliberate attention and non-judging observation (Brown & Ryan, 2003; Kabat-Zinn, 2003). This definition also highlights the non-reliance on heuristics, but does so through deliberate attentional shifts, rather than priming. As it is the goal of this study to

determine the effectiveness of resources that can be consciously activated, the second definition of mindfulness will be used throughout.

Mindfulness can be treated as either an individual trait that varies between people, or a temporary state that varies within-person over time (Carmody & Baer, 2008). Both Buddhist teachings and clinical psychology attempt to increase state and trait mindfulness through various exercises, practices, and behaviors (Baer, 2003; Kabat-Zinn, 2003). Common practices such as yoga and meditation have been associated with higher reported trait mindfulness (Carmody & Baer, 2008) as well as temporary increases in state mindfulness during and immediately after the practice (Miller, Fletcher, & Kabat-Zinn, 1995). For the purposes of this study, I focused on state mindfulness.

One of the barriers for applying mindfulness within organizations is the high time cost associated with mindfulness training (Carmody & Baer, 2008). Most mindfulness initiatives require multiple sessions that can last anywhere from one to three hours, in addition to practice and follow-up sessions (e.g., Carmody & Baer, 2008). This is not feasible for most organizations or employees who have limited time available. Previous studies, however, examined the effectiveness of a one-time, one-hour-long mindfulness intervention (Kiburz, 2012; Michel, 2014) or four, half-hour sessions (Mackenzie, Poulin, & Seidman-Carlson, 2006). Kiburz (2012) found that even one short dose of a mindfulness intervention was effective at increasing mindfulness in the short-term (i.e., state mindfulness) as well as positive outcomes (e.g., decreased work family conflict) weeks later. As such, mindfulness induction holds promise as a potential intervention for organizations aiming to increase mindfulness in their employees. Therefore, I hypothesize:

(3) Individuals who receive a mindfulness-based induction intervention will report higher state mindfulness compared to those who received an active control intervention.

Mindfulness and Work

With regard to the theory of mental workload (e.g., Navon & Gopher, 1979), mindfulness can be considered a method by which individuals increase their cognitive resources and reduce the negative effects of demands. I argue this occurs not only through an increase in overall resources, but through better allocation of overall resources. Mrazek and colleagues (2013) found evidence to suggest that mindfulness was associated with decreased mind-wandering (i.e., increased focused attention). This decrease in mind wandering may parallel an increased focusing of attention on the task. Increased attention on a task, or in other words, decreased mind wandering, has been shown to decrease the time required to complete the task (Stankov, Roberts, & Spilsbury, 1994). Therefore, I hypothesize:

(4a) Individuals who report higher levels of mindfulness will complete a secondary task more quickly than those that report lower levels of mindfulness.

In a maximally mindful state, individuals should have a greater, and more efficient, command over their attention, behaviors, and cognition. This increased efficiency reduces the cognitive demands placed on the individual to complete the required tasks, thereby reducing perceived mental workload (Navon & Gopher, 1979). Because mindfulness empowers individuals to act and think with intention more efficiently, it should reduce the demand placed on cognitive resources. Specifically, it enables an individual to adapt to changes in the task through resource re-allocation, rather than unnecessarily focusing on the increased task demands or lack of resources (Garland, Gaylord, & Park, 2009). Therefore, I hypothesize:

(4b) Individuals who report higher levels of mindfulness will report lower levels of perceived mental workload than those that report lower levels of mindfulness.

Furthermore, research suggests that state mindfulness, in particular, increases individuals' working memory capacities (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; Mrazek et al., 2013). Working memory is a type of cognitive resource. Greater working memory increases the capacity for dealing with cognitive demands (e.g., Navon & Gopher, 1979). Thus, as working memory increases, perceived mental workload should decrease. Increased working memory, coupled with more efficient direction of attention should enable an individual to complete both the primary and secondary tasks without having to sacrifice performance on the primary task (e.g., Stankov, Roberts, & Spilsbury, 1994). Therefore, I hypothesize:

(5a) The moderating effect of mindfulness on the relationship between intrusions and perceived mental workload will carry through to the number of errors made, such that the mediated relationship between intrusions and number of errors made will be weaker when individuals report higher levels of state mindfulness than those that do not.

Mindfulness and Strain

In clinical psychology, mindfulness has been used as a tool to decrease stress and to treat borderline personality disorder and other mood disorders (Baer, 2003; Kabat-Zinn, 2003). Mindfulness-Based Stress Reduction (Shapiro, Schwartz, & Bonner, 1998) is potentially one of the most frequently used mindfulness interventions in modern clinical psychology. It aims to teach individuals how to direct their attention with intention. By deliberately re-directing attention and being aware of one's own reactions and cognitions, individuals are able to avoid maladaptive thoughts and behaviors, and ultimately reduce strain.

In line with the theory of mental workload (e.g., Navon & Gopher, 1979), mindfulness interventions give trainees cognitive resources with which to combat the negative effects of demands placed upon them, thereby reducing perceived mental workload, and ultimately, strain (e.g., Jex, 1998). Mindfulness can also help individuals better allocate their resources, through heightened awareness of task management. Thus, mindfulness may serve not only as a resource itself, but also as a mechanism by which one can more efficiently utilize other cognitive resources in order to reduce perceived mental workload. Specifically, there is evidence to suggest that mindfulness training can help individuals alter their appraisals of stressors, such that they perceive stressors as more benign (Weinstein, Brown, & Ryan, 2008). Weinstein and colleagues (2008) suggest that it is altered appraisals of stressors, coupled with a change in coping strategies (i.e., allocation of mental resources) that led to decreased reports of perceived stress and anxiety in their dataset. It follows, that similar to Weinstein and colleagues' (2008) findings, mindfulness may specifically alter the perceived mental workload associated with an intrusion, thereby reducing stress and anxiety. Therefore, I hypothesize:

(5b) *The moderating effect of mindfulness on the relationship between intrusions and perceived mental workload will carry through to anxiety, such that the mediated relationship between intrusions and anxiety will be weaker when individuals report higher levels of state mindfulness.*

(5c) *The moderating effect of mindfulness on the relationship between intrusions and perceived mental workload will carry through to stress, such that the mediated relationship between intrusions and stress will be weaker when individuals report higher levels of state mindfulness.*

The Present Study

This study aimed to examine the relationship between intrusions and performance and strain. This relationship was hypothesized to be mediated by perceived mental workload (See Figure 1). Furthermore, state mindfulness (an outcome of the mindfulness induction condition) was hypothesized as a moderator of the relationship between intrusions and perceived mental workload.

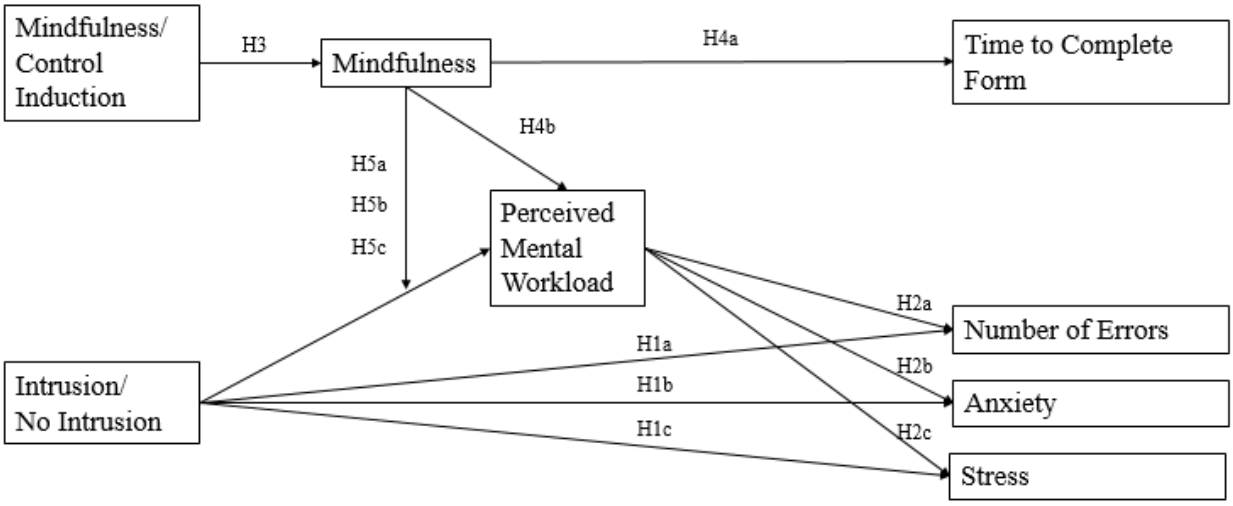

Figure 1. Visualization of hypotheses.

CHAPTER TWO

METHOD

Participants

Results from a power analysis using G*Power (Erdfelder, Faul, & Buchner, 1996; Faul, Erdfelder, Lang, & Buchner, 2007) suggested that 119 participants were needed to find a medium effect size ($F^2 = .15$). Similarly, using a modified version of the N:P ratio of 30 participants per condition (Cohen, Cohen, West, & Aiken, 2013; VanVoorhis & Morgan, 2007), one finds a necessary sample size of 120 participants. All participants were volunteers and received course credit for participation. Due to the nature of the primary task, individuals were not be able to participate if they were color blind. Further, participants could not have previously participated in any study using the primary task.

To be conservative, and account for potential missing or bad data, 160 participants were recruited. One case could not be analyzed due to a technical difficulty in saving the data. Of the remaining 159 cases, 47 cases were removed from further analysis due to missing data (i.e., more than 20% of items were not answered; $n = 6$), failing more than 20% of attention checks ($n = 2$), or other signs of failed attention (i.e., zero standard deviation on at least three scales; $n = 40$), or some combination of these indicators. This initial data screen resulted in a final sample of 112 undergraduate students ($M_{age} = 19.50$, $SD_{age} = 3.35$, 69.6% female). When asked to endorse all applicable ethnicities, 53.6% identified as Caucasian, 13.4% Black/African American, 25.9% Hispanic/Latino, 9.8% Asian, 5.4% Middle Eastern, and 2.5% other/did not report. A majority of participants reported being single (94.6%), while only one reported being married, one reported

being separated, and four reported living with another or in a domestic partnership. With regard to employment status, 66.9% of participants reported being not employed, 26.8% reported being employed part-time, 4.5% reported being employed full-time, one participant reported being self-employed, and one participant did not provide an answer. Results of multiple analysis of variances (ANOVAs) indicate that there were no significant differences between randomly assigned groups in any measured demographic variables or current mindfulness practices (i.e., yoga, meditation, or deep prayer).

Materials

Task Training

Task-based training (Appendix A) was designed using the science of training (Kraiger & Aguinis, 2001; Salas & Cannon-Bowers, 2001), which suggests that information, demonstration, practice, and feedback are required for effective training. Information was provided during a six-minute training video. Participants were given a sample deck of cards from the primary task, and were allowed to use them during the training video which explained the types of cards, as well as the rules of the task, and proper methods of completing it. The video also included an aspect of demonstration, during which the instructor sampled sorting the cards according to the rules, focusing on particularly problematic rules that participants were likely to have trouble with during performance. During the video, participants were given one minute to familiarize themselves with the cards by manipulating them, looking through the deck, sorting them, etc.

To ensure that the participants were prepared to complete the task and felt adequately trained, they were next given an opportunity to practice sorting the cards according to the instructions in the video. They were told that this was practice for the upcoming task. Participants were stopped if they had not completed sorting the cards after ten minutes.

Following completion of practice, the experimenter walked the participant through the scoring of the task, showing them the key (Appendix B). Feedback was provided during this step, as the experimenter explained to the participants what mistakes they made, and how to improve their performance the next time they completed the task, according to the instructions laid out in the task-based training video.

Mindfulness Induction

The state mindfulness induction was based on the shortened mindfulness intervention carried out by Kiburz (2012). This induction was an audio recording (Appendix C) containing information about mindfulness, as well as one mindfulness exercise. First, the recording of the instructor gave general information about the induction, and then specific information about the exercise. Following the information for the exercise, the recording of the instructor included an audio demonstration of how to engage in the behaviors. Following this, there was a period of twenty-five minutes when the participant was instructed to practice the behavior. During this period, there were brief moments of feedback regarding finer points of mindfulness exercises.

The exercise was a method of purposeful breathing, marked by heightened awareness. During this exercise, participants were instructed to sit comfortably, with their feet firm upon the floor and their backs straight. Attention was directed toward the breath and the pattern of inhalation and exhalation. Participants were instructed to clear their minds of thoughts, and if their thoughts wandered, to simply take note and redirect their attention to the breath, without passing judgment upon themselves. Thought provoking questions (Appendix D) such as “where did your mind wander? and what sensations did you notice when you focused on your breath?” were presented regarding this particular exercise once the entire induction had been completed. These were designed to provide an opportunity for self-reflection and for changes made in the

induction to be identified and solidified. Further, it allowed individuals to report if they stopped paying attention to the induction video. Following these questions, participants were given a three-item mindfulness knowledge test as a form of a manipulation check (Appendix E). Results of a t-test ($t(101) = 4.23$, $p < .001$) suggest that individuals who received the mindfulness induction ($M = 2.27$, $SD = 0.77$) learned significantly more about mindfulness than those in the control induction group ($M = 1.67$, $SD = 0.65$), thereby suggesting that participants paid attention to the intervention and that it was effective in presenting the training material.

Control Induction

The control induction consisted of an audio recording (Appendix F) of a sham mindfulness induction designed to encourage mind wandering (Garland, Handley, Farb, & Froeliger, 2015; Zeidan, Johnson, Gordon, & Goolkasian, 2010). Zeidan and colleagues (2010) used a sham induction to make participants believe they were meditating and receiving the benefits of mindfulness, without receiving the true induction. The study found that the "real" mindfulness induction reduced tension, depression, and physiological symptoms of strain (e.g., heart rate) while also bolstering mood. At the same time, however, the sham mindfulness participants all believed they were meditating, but they did not see as great of a reduction in heart rate, or tension, nor did they report any changes in depression symptoms, and were no different than the control group that received no induction in any category. Moreover, the control induction used in the present study was used as a control by Garland and colleagues (2015). They found that the mind wandering condition resulted in significantly less reported mindfulness than the mindfulness condition and, thus, significantly less cognitive reappraisal. This follows the conceptual and theoretical distinctions between mindfulness (intentional focused attention) and mind-wandering (unintentional unfocused attention).

I relied upon the use of an active control group rather than a no induction control group for two specific reasons. First, use of a no-induction control group would introduce potential confounding variables of time spent in the study and differences in fatigue. Given that the mindfulness induction was twenty-five minutes long, not providing an induction as a control would greatly, and systematically reduce the amount of time participants in the control condition were in the experiment prior to completing the task. Therefore, I would be unsure as to whether any results found were as a result of changes in fatigue, comfort with the environment, or any other host of variables related to time in the lab. Second, use of an active control induction is more conservative than use of a no-induction control condition. Any changes in state such as potential comfort with the lab or potential relaxation that could bolster performance and decrease strain would be accounted for through the active control induction. Therefore, any effects found were above and beyond these variables, and thus can more accurately be attributed to the induced mindfulness. Furthermore, Zeiden and colleagues' (2010) findings that a similar sham mindfulness induction did not differ significantly from no-induction conditions indicates that any differences between the sham mindfulness condition and the true mindfulness condition would likely also hold against a less powerful no-induction condition. Additionally, Garland and colleagues (2015) suggest that the mind wandering sham induction is a relatively higher fidelity experience for participants, given that mind wandering occurs naturally throughout the day. Thus the sham mind wandering induction essentially supported or highlighted normal behavior.

In order to avoid effects of condition quality, following the presentation of general information, participants in the control induction were guided through the only exercise (lasting twenty-five minutes). Similar to the mindfulness induction, this exercise was again introduced as "sitting with the breath," but after initial information about the benefits of relaxation, the only

instructions given to the control induction group were “as you sit with your breath, just allow your mind to roam,” etc. Both videos had the same background music playing the entire time to reduce distractions and enhance the experience as well as the similarity of the two inductions. Following the exercise, participants were asked to respond to the same open-ended questions about the lessons they learned (Appendix D), as well as the same mindfulness knowledge scale (Appendix E), that those in the mindfulness induction condition were asked to complete.

Task Materials

Checklist

A checklist designed to aid in completion of the primary task (Appendix G) was provided. This checklist has been shown to provide maximal resources but at the cost of a high level of cognitive load, because it was designed to intentionally ignore adult learning principles such as chunking (e.g., Gobet et al., 2001). Again, this was high fidelity, given that many checklists designed to aid in task completion have been shown to be too cognitively taxing to be helpful (Degani & Wiener, 1993). Each small step was listed out, resulting in useful instructions, but a high level of cognitive demand associated with use. This was chosen to increase the perceived mental workload associated with task completion should the checklist be used. However, poor checklist design has been suggested to actually increase errors (Verdaasdonk, Stassen, Widhiasmara, & Dankelman, 2009) so the checklist was designed based on empirically supported design principles to avoid the confound of checklist use resulting in errors. Specifically, information was presented in only one column (Degani & Wiener, 1993), each step was able to be physically checked off (Degani & Wiener, 1993), and no ambiguous language or jargon was used (Verdaasdonk et al., 2009). In accordance with an empirically supported suggestion of effective checklist use (Degani & Wiener, 1993), participants were given a marker

to check off items as they completed the task. Further, this specific checklist has been shown to be useful, but not ideal, for completion of the primary task, in that it has been shown to increase time required to complete the task, which aligns with its use in this study as a cognitively demanding resource (Fletcher, 2015).

Primary Task

There was a timer visible to the participants, so they could gauge their progress against the goal time of completion. Participants were informed that they only had 8 minutes to complete the task, in order to create a sense of time pressure, taxed resources, and, ultimately, increased perceived mental workload (e.g., Jex, 1998). A deck of 60 cards from the card game Blink was used for task completion. Each card presented a certain number (ranging from one to six) of one type of symbol. The symbols consisted of lightning bolts, triangles, rain drops, stars, flowers, and moons. The symbols were also presented in only one of six colors on each card (viz., blue, brown, green, grey, red, and yellow). Thus, each card depicted one number, one symbol type, and one color (e.g., two blue lightning bolts, six green triangles). Participants were instructed to sort the cards according to the task-based training and verbal instructions, resulting in a very specific pattern, so that there were only two possible correct solutions that were equally likely.

The correct solution required the cards to be sorted in a grid such that each row contained only one color. The rows of colors had to be aligned alphabetically by color name. Participants were informed that for the purposes of this study, grey was spelled G-R-E-Y. Further, each row was to be sorted such that the numbers on the cards within the row adhered to the following order: 1,2,3,4,5,5,4,3,2,1. No two cards of the same symbol were allowed to be adjacent to one another in either the row or the column. Additionally, the instructions required that several

"special" cards, such as the green two of stars, be in a specific location on the grid. Finally, the instructions required other specific cards to be removed and set to the side.

Secondary Task

A form that participants were instructed to fill out (Appendix H) was used as the intrusion task. Participants were told:

> *I am so sorry to interrupt you, but I need to enter some information right now so you can receive your SONA credit. Our lab has some strict requirements about assigning SONA credit. I need you to fill out this form, completely and accurately. I cannot pause your time, otherwise the timer restarts. So if you could hurry and complete this form that would be great.*

This was designed to create incentive and motivation to completely shift attention to the form and away from the primary task. Again, this was designed to highlight the time pressure, resulting in increased demands, and thus, perceived mental workload. When participants returned to the primary task, the experimenter reminded them of how much time they had left.

Measures

Demographics

Participants were asked to provide certain demographic information (Appendix I), such as sex, age, ethnicity, and experience with mindfulness practices.

Perceived Mental Workload

Perceived mental workload was measured using a modified version of the NASA Task Load Index (NASA-TLX; Hart & Staveland, 1988). This measure of perceived workload has been shown to be sensitive and specific, and has also been suggested to be more helpful than other leading subjective workload measures, such as the SWAT (subjective workload assessment

technique) when the workload is low (Nygren, 1991). Furthermore, the NASA-TLX captures multiple types of workload, including physical, mental, time, effort, performance, and frustration (Nygren, 1991). The scale consists of six items rated on a seven-point Likert scale from *"very low demand"* to *"very high demand."* Originally, these items were meant to be weighted based on the perceived importance of each dimension (physical, mental, time, effort, performance, frustration). Given that this study focuses on perceived mental workload and that stress is an outcome in this study, only the mental, time, and effort sub-scales of the NASA-TLX (Appendix J) were used to create a composite perceived mental workload variable. The physical subscale was removed because it is not relevant to the task, and the performance and frustration subscales were excluded because they were, in this study, outcome variables, not to be included in the mediator. This scale was found to have an adequate reliability (α = .88).

Given the nature of the proposed mediated relationship, it would have been ideal to measure perceived mental workload during task execution, so as to better establish temporal causality. However, this could not be done without creating an intrusion for the control condition, thus eliminating the control effect. Therefore, perceived mental workload was measured immediately following task completion and explicitly asked participants to refer to their experience during task execution.

State Mindfulness

State mindfulness was measured using the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013; Appendix K). This scale contained 25 items that participants responded to on a five-point Likert-type scale (*1 = not at all, 5 = very much).* Items targeted two domains of mindfulness: awareness of the body, and awareness of the mind. A sample item is "*I noticed pleasant and unpleasant emotions."* Depending on the administration point (i.e., baseline prior to

task-based training, or post-mindfulness/control induction), the participant was given a specific time frame to consider when responding to the items (i.e., the most recent thirty minutes, the period of the mindfulness induction exercise, respectively). This scale was found to have an adequate reliability (α_{T1} = .86, α_{T2} = .94, α_{T3} = .95).

Training Reactions

Training reactions were measured using the seven-item subscale (Appendix L) of "Utility Reactions" adapted from Morgan and Casper (2000). Items were rated on a five-point Likert-type scale (*1 = very dissatisfied, 5 = very satisfied*). A sample item is, "*How satisfied are you with the extent to which this training course prepared you to perform new tasks*?" This scale was administered after the completion of the task-based training. This scale was found to have an adequate reliability (α = .85).

Primary Task Performance

Performance for the primary task focused solely on accuracy. Errors were calculated based on the number of individual cards that were not in the correct spot, with a theoretical, and actual, minimum of zero errors and a maximum of sixty (*M* = 20.25, *SD* = 13.64).

Secondary Task Speed

Speed of the secondary task was calculated based on the how long it took the individual to fill out the SONA form to their satisfaction. Participants were allowed to leave anything they did not know blank. The period of completion (*Min* = 20 second, *Max* = 180 seconds) started when the participant began writing and finished when the participant stopped writing and handed the experimenter the form.

Intrusion Time

The length of the entire intrusion, from the moment the researcher stopped progress on the task to the moment the participant returned to the task was recorded as well. For participants who were not in the intrusion condition, this value was zero. For participants who were in the intrusion condition, the minimum time was 34 seconds and the maximum value was 402 seconds. These values were used as a control variable in the analyses, to account for the reduced amount of time participants had to complete the task, which would inherently affect their progress on the task, above and beyond the cognitive- and strain-based effects of being interrupted.

Psychological Strain

Psychological strain was measured using the anxiety (α_{T1} = .88, α_{T2} = .92) and stress (α_{T1} = .94, α_{T2} = .93) subscales of the Depression Anxiety Stress Scale (Appendix M; Lovibond & Lovibond, 1995). The anxiety subscale measured perceptions of autonomic arousal, skeletal musculature effects, subjective experience of anxious affect, and situational anxiety. There were 14 items measuring anxiety, rated on a seven-point Likert-type scale (*1 = Strongly Disagree, 7 = Strongly Agree*). A sample item is, "*I was aware of dryness of my mouth."* The stress subscale measured five aspects: difficulty relaxing, nervous arousal, easily upset/agitated, irritable/over-reactive, and impatient. These were measured using 13 items, also all rated on the same seven-point Likert-type scale. A sample item from the stress subscale is, "*I found myself getting upset rather easily.*"

To better ensure that temporal causality was able to be determined, psychological strain was measured after perceived mental workload. Further, instructions associated with these measures explicitly asked participants to reflect on their present experience (i.e., immediately

following the task), not the experience during task execution. This strategy was used to better establish temporal causality without reducing the efficacy of the control conditions.

Perceived Intrusions

Perceived intrusions were measured using a modified four-item version of a perceived intrusions scale (Appendix N; α = .91; *M* = 2.93, *SD* = 1.23, Skewness = -0.27, Kurtosis = -1.13; Fletcher, Potter, & Telford, 2016). Participants were instructed to answer items with regard to the time they spent completing the task. Items were rated on a six-point Likert-type scale (*1 = Never, 6 = Very Frequently*). A sample item is "*Other people prevented me from making progress on a task I was working on.*"

Procedure

For a visualization of the procedure, see Figure 2. For a visualization of the different progressions of the procedure for each of the four conditions, please see Figure 3. Participants were first informed of the risks and benefits of the study. If they agreed to continue, participants were randomly assigned to one of four conditions: mindfulness induction with intrusion, mindfulness induction with no intrusion, control induction with intrusion, or control induction with no intrusion. Participants were then led to a small room, lit by electronic candles, a reading lamp, and the computer monitor. Participants were instructed to leave their belongings, including electronic devices, outside of the room for the duration of the study. The remaining experimental activities all took place in this isolated room, in order to minimize interruptions. Participants were also given headphones to use in order to listen to audio recordings. Participants completed a demographic questionnaire, self-report psychological strain, and the SMS. They were then trained on the primary task using a short instructional video. All participants received the same

task-based training and were given an opportunity to practice the task once, and received feedback regarding their performance.

Participants then underwent twenty-five minutes of mindfulness (or control) induction, as described above. During this induction, the experimenter left the room and closed the door, leaving the participant alone. Participants were instructed to not pause, fast-forward, or rewind the video. The experimenter would open the door when the video had finished. Following this, participants completed the SMS again. Participants were then instructed to complete the sorting task as quickly and accurately as possible. All participants were given a checklist that had information needed to complete the task. All participants were given a goal to finish the task in under eight minutes, a time frame created from previous data collected using the primary task. This time frame should have allowed nearly all participants to complete, or nearly complete, the primary task with moderate time pressure, if their performance was not interrupted by the secondary task. Participants then began the task and were able to see their time progress on a digital timer. Three minutes into the task, the experimenter allowed the clock to keep running and interrupted the participants in the intrusion condition with an intruding task (a SONA credit form to complete). Three minutes was selected as the ideal time for the interruption given the need to allow participants to become fully immersed within the task, but also to avoid a case in which the participant completed the task before the designated point at which the interruption should occur. Other studies examining the effects of interruptions have found that the effects are worse if participants are in the middle of task execution as compared to having just began or nearly finished (e.g., Adamczyk & Bailey, 2004; Czerwinski, Cutrell, & Horvitz, 2000), hence the timing of the intrusion in the present study.

When participants had completed the intruding task, they were told to return to the primary task and were informed of their remaining time. Individuals in the no intrusion condition were not interrupted, and were asked to complete the SONA form immediately following primary task completion, prior to completing ratings, so as to ensure that the SONA form was still included as part of the participants' experience of the overall task. Following overall completion of the tasks, participants completed the perceived mental workload questionnaire, psychological strain questionnaire, and the SMS. Participants were then verbally debriefed, thanked, and shown out.

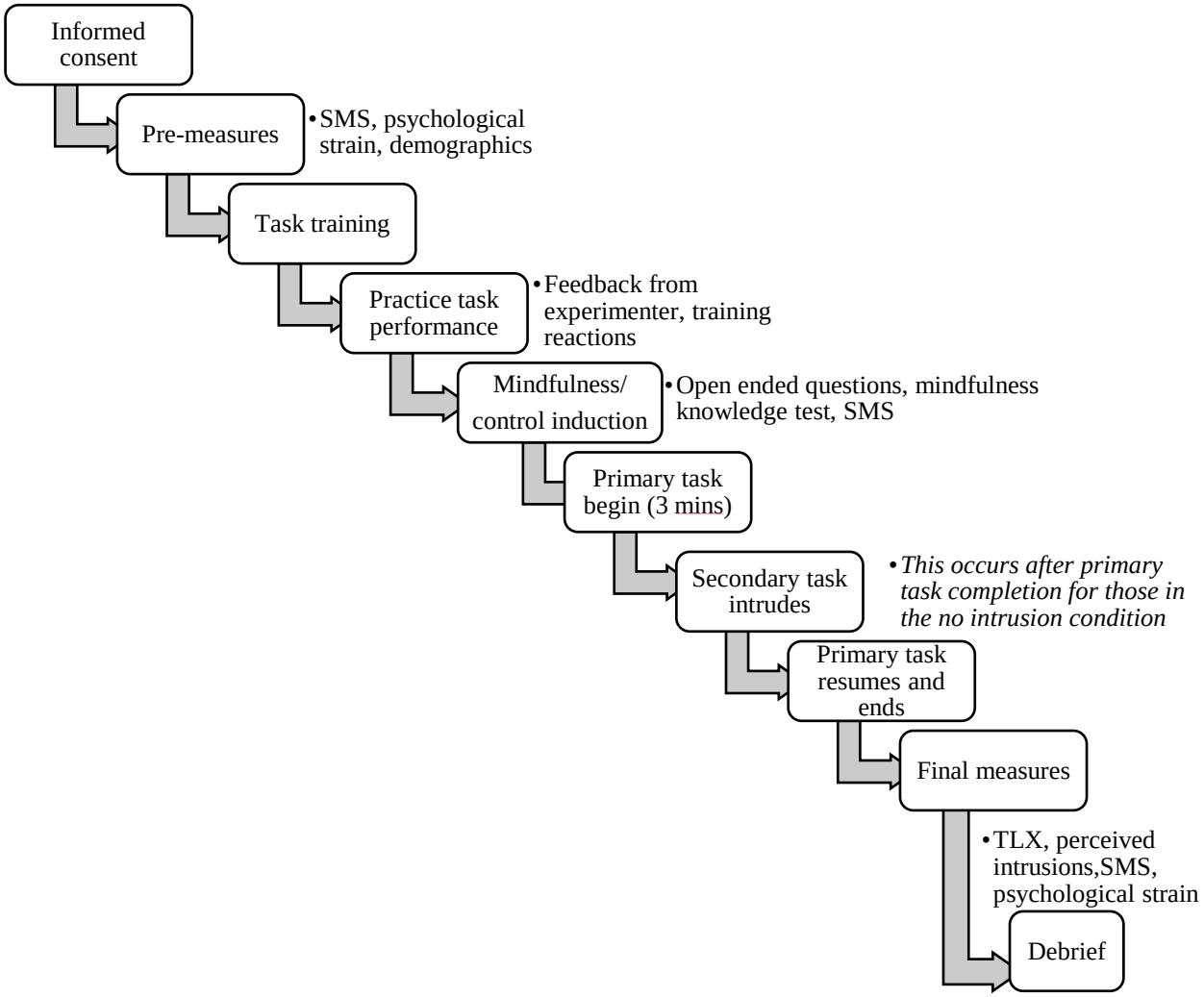

Figure 2. Visualization of the experimental procedure.

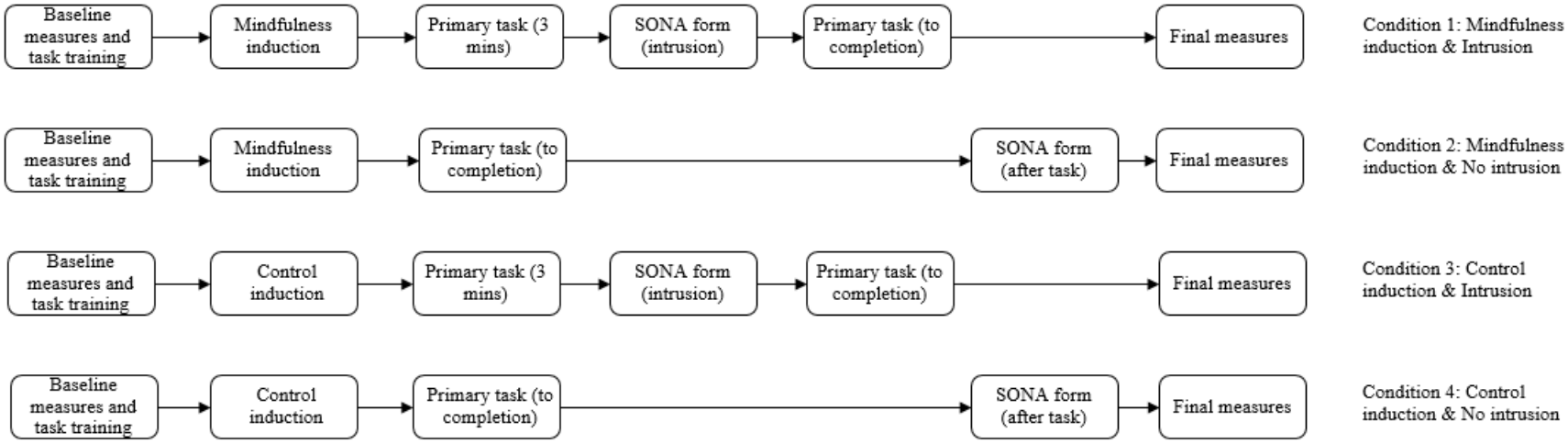

Figure 3. Visualization of the four different conditions.

CHAPTER THREE

RESULTS

Means, standard deviations, skewness, kurtosis, reliabilities, and intercorrelations are provided in Table 2. Means by experimental condition are presented in Table 3. Examining the skewness and kurtosis reveals that age (skewness = 5.96, kurtosis = 41.94) and task time (skewness = -2.80, kurtosis = 7.89) were non-normal. However, given that these variables were not central to the study's hypotheses, nor would one expect them to be normal given the nature of the population and the cut-off time for task completion, they were considered to have minimal influence on the results, and thus analyses were completed as planned. All normality-related results were confirmed by examining the Q-Q plots and histograms. Examining the histograms revealed significant outliers on many measures, but given that no one individual was a significant outlier on multiple measures, all participants were retained.

Hypothesis Testing

Hypotheses 1a proposed that individuals who experienced an intrusion during a primary task would make more errors than those who did not. Hypothesis 1b proposed that individuals who experienced an intrusion during a primary task would experience more anxiety than those who did not. Lastly, Hypothesis 1c proposed that individuals who experienced an intrusion during a primary task would experience more stress than those who did not. These hypotheses were tested using three separate ANCOVAs with intrusion condition as an independent variable and errors, anxiety, and stress, respectively, as dependent variables. Individuals in the intrusion condition (n = 58, M = 23.10, SD = 14.65) did not make significantly more errors than those in

Table 2

Means, Standard Deviations, Skewness, Kurtosis, and Intercorrelations of Study Variables

	M *SD*	Skew *Kurtosis*	1	2	3	4	5	6	7	8	9	10	11	12	13
1.Anxiety (T1)	2.45 *1.04*	0.82 *0.59*	*(.88)*												
2. Stress (T1)	2.68 *1.35*	0.71 *-0.70*	**.73***	*(.94)*											
3. State Mindful (T1)	3.12 *0.74*	-0.18 *-0.69*	**.31***	.**24***	*(.86)*										
4. State Mindful (T2)	3.63 *0.66*	-0.50 *0.48*	.05	.04	**.39***	*(.94)*									
5. Per. Mental Workload (T3)	4.67 *1.38*	-0.57 *0.03*	.07	.03	**.23***	.08	*(.88)*								
6. Per. Intrusions (T3)	2.93 *1.23*	-0.27 *-1.13*	**.24***	**.32***	**.25***	.11	**.18***	*(.91)*							
7. Anxiety (T3)	2.42 *1.04*	0.59 *-0.68*	**.66***	**.57***	.15	.15	**.26***	**.29***	*(.92)*						
8. Stress (T3)	2.82 *1.26*	0.38 *-0.94*	**.51***	**.64***	.07	.15	**.21***	**.40***	**.71***	*(.93)*					
9. State Mindful (T3)	3.24 *0.70*	-0.46 *0.14*	**.30***	**.30***	**.43***	**.54***	.18	**.17**	**.38***	**.36***	*(.95)*				
10. Time: SONA Form	75.84 *42.51*	1.23 *1.90*	-.08	-.04	.00	.11	-.03	-.08	.03	-.05	.04				

Table 2 (Continued)

	M *SD*	Skew Kurtosis	1	2	3	4	5	6	7	8	9	10	11	12	13
11. Task Time	468.63 *33.54*	-2.80 *7.89*	**.19***	.09	.05	-.02	**.23***	.15	.08	-.04	.03	.00			
12. Task Errors	20.04 *13.61*	0.59 *0.17*	.14	.08	.02	.08	.07	.13	.09	.04	-.06	.14	.07		
13. Intrusion Condition			-.06	-.02	.12	.10	-.03	**-.39**	-.02	-.04	.12	-.02	**-.19***	**-.25***	
14. Mindfulness Condition			.05	.09	.08	.02	-.02	.13	-.01	.04	-.07	-.13	-.06	.04	-.09

Note: T1 = Baseline, T2 = Post-induction, T3 = Post-task completion, Intrusion condition is coded as 1 = intrusion, 2 = no intrusion, Mindfulness condition is coded as 1 = mindfulness induction, 2 = control induction. *significant at $p < .05$.

Table 3

Means and Standard Deviations by Experimental Condition

	Intrusion and Mindfulness Induction		Intrusion and Control Induction		No Intrusion and Mindfulness Induction		No Intrusion and Control Induction	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Anxiety (baseline)	2.50	*0.91*	2.54	*1.24*	2.32	*1.05*	2.45	*0.90*
Stress (baseline)	2.58	*1.15*	2.74	*1.49*	2.48	*1.27*	2.84	*1.36*
Mindfulness (baseline)	2.96	*0.76*	3.08	*0.77*	3.13	*0.64*	3.29	*0.79*
Mindfulness (post induction)	3.47	*0.61*	3.70	*0.69*	3.81	*0.60*	3.59	*0.62*
Perceived Mental Workload	4.86	*1.37*	4.67	*1.46*	4.65	*1.55*	4.62	*1.18*
Perceived Intrusions	3.22	*0.71*	3.37	*0.69*	2.39	*1.15*	2.64	*1.19*
Errors	19.54	*15.85*	26.69	*13.06*	19.71	*10.37*	13.54	*12.32*
Anxiety (post task)	2.40	*0.83*	2.50	*1.14*	2.47	*1.16*	2.33	*0.99*
Stress (post task)	2.72	*1.10*	3.03	*1.40*	2.84	*1.25*	2.73	*1.29*
Mindfulness (post task)	3.15	*0.78*	3.17	*0.78*	3.43	*0.57*	3.22	*0.64*

the control condition after covarying the time required by the intrusion (n = 54, M = 16.74, SD = 11.67; $F(1,109) = 0.81$, $p = .37$), failing to support Hypothesis 1a. Results of an ANCOVA failed to find a significant difference between conditions with regard to anxiety after controlling for baseline anxiety and time required to complete the intrusion; $F(1,108) = 0.76$, $p = .39$, thus

failing to support Hypothesis 1b. Similar results were found for stress after controlling for baseline stress and time required to complete the intrusion ($F(1,108) = 0.01$, $p = .91$), therefore, Hypothesis 1c was not supported.

Hypothesis 2a proposed that perceived mental workload would partially mediate the relationship between an intrusion and the number of errors made. Results of a modified version of the Sobel test (1982), developed by Preacher and Hayes (2004), using bootstrapping failed to support Hypothesis 2a (Table 4). The analyses were conducted using the macro for SPSS developed by Preacher, Rucker, and Hayes (2007) that provided estimations of the indirect effects through the comparison of the bootstrapped confidence intervals (considered non-significant if they include zero), the Sobel test, and the stepwise procedure (Baron & Kenny, 1986). All bootstrapping tests were run using a sample size of 5000. After controlling for intrusion time, intrusion condition did not significantly predict perceived mental workload ($B = 0.06$, $SE(B) = 0.39$, $p = .87$, $CI_{95\%} = [-0.71, 0.84]$), nor did perceived mental workload predict errors ($B = 0.57$, $SE(B) = 0.87$, $p = .52$, $CI_{95\%} = [-1.16, 2.29]$). Further, the Sobel test for indirect effects was non-significant ($z = 0.09$, $p = .93$) as were the bootstrapped results (*effect* = 0.04, *SE* = 0.49, $CI_{95\%} = [-0.81, 1.32]$). Thus, these results failed to support Hypothesis 2a.

Hypothesis 2b proposed that perceived mental workload would partially mediate the relationship between an intrusion and anxiety. Hypothesis 2c proposed that perceived mental workload would partially mediate the relationship between an intrusion and stress. Similarly, results of two bootstrapped tests for mediation failed to find significant support for Hypotheses 2b and 2c. Although intrusion condition was not a significant predictor of anxiety (Table 5; $B = 0.07$, $SE(B) = 0.39$, $p = .87$, $CI_{95\%} = [-0.71, 0.84]$), perceived mental workload was found to significantly predict anxiety ($B = 0.19$, $SE(B) = 0.07$, $p < .01$, $CI_{95\%} = [0.06, 0.33]$). Results of a

Sobel test for indirect effects were non-significant (z = 0.16, p = .88) as were the bootstrapped results (*effect* = -0.01, *SE* = 0.05, $CI_{95\%}$ = [-0.12, 0.09]), thus failing to support Hypothesis 2b. A similar pattern of results (Table 6) were found with stress as an outcome variable, therefore failing to support Hypothesis 2c. Intrusion condition was not a significant predictor of stress (B = -0.31, *SE(B)* = 0.44, p = .49, $CI_{95\%}$ = [-1.19, 0.57]), but perceived mental workload was found to significantly predict stress (B = 0.19, *SE(B)* = 0.09, p = .03, $CI_{95\%}$ = [0.01, 0.37]). Results of a Sobel test for indirect effects was non-significant (z = 0.15, p = .88) as were the bootstrapped results (*effect* = 0.01, *SE* = 0.10, $CI_{95\%}$ = [-0.15, 0.26]). Overall, these results failed to support Hypothesis 2c.

Hypothesis 3 proposed that individuals who received a mindfulness-based induction intervention would report higher state mindfulness compared to those who received an active control intervention. Results of an ANCOVA, in which baseline state-mindfulness was entered as a covariant, mindfulness condition was entered as the independent variable, and post-induction state mindfulness was the outcome variable, failed to support Hypothesis 3. Specifically, after controlling for baseline state mindfulness (F(1,107) = 7.85, p < .001), mindfulness condition did not significantly predict post-induction state mindfulness (F(1,107) = 0.19, p = .67), suggesting that individuals who received the mindfulness induction (M = 3.65, SD = 0.62) did not report a significantly higher level of state mindfulness than those in the control induction condition (M = 3.65, SD = 0.65). A follow-up t-test, however, suggests that while state mindfulness did not differ by group either at baseline (F(1,110) = 0.78, p = .38) or after the inductions (F(1,109) = 0.06, p =.80), all groups reported significantly higher levels of mindfulness following the inductions (M = 3.63, SD = 0.66) compared to the baseline (M = 3.12, SD = 0.74; t(110) = 6.97, p < .001).

Table 4

Mediational Test of Interruption Condition Predicting Errors, Controlling for Intrusion Time

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)* *LL 95% CI*	*Confidence Interval (CI)* *UL 95% CI*
Direct and Total Effects						
Perceived mental workload regressed on condition, controlling for intrusion time	0.06	0.39	0.17	.87	-0.71	0.84
Perceived mental workload regressed on intrusion time, controlling for condition	0.00	0.00	0.49	.62	-0.00	0.01
Errors regressed on perceived mental workload, controlling for condition and intrusion time	0.57	0.87	0.65	.52	-1.16	2.29
Errors regressed on condition, controlling for mental workload and intrusion time	-3.66	3.46	-1.06	.29	-10.52	3.21
Errors regressed on intrusion time, controlling for perceived mental workload and condition	0.03	0.02	1.13	.26	-0.02	0.07
Errors regressed on condition (total effects model), controlling for intrusion time	-3.62	3.44	-1.05	.30	-10.44	3.22

Indirect Effect and Significance Using Normal Theory				
	Effect	*SE*	*z*	*p*
Sobel-Perceived mental workload	*0.04*	*0.41*	*0.09*	*.93*

	Bootstrap Results for Indirect Effects		*Bootstrap CI*	
	Effect	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload	*0.04*	*0.49*	*-0.81*	*1.32*

Note. n = 112. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion. $\boldsymbol{R^2 = .06, F(2, 109) = 3.84, p = .03}$

Table 5

Mediational Test of Interruption Condition Predicting Anxiety, Controlling for Intrusion Time

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)* *LL 95% CI*	*UL 95% CI*
Direct and Total Effects						
Perceived mental workload regressed on condition, controlling for intrusion time	0.07	0.39	0.17	.87	-0.71	0.84
Perceived mental workload regressed on intrusion time, controlling for condition	0.00	0.00	0.49	.62	-0.00	0.01
Anxiety regressed on perceived mental workload, controlling for condition and intrusion time	**0.19**	**0.07**	**2.88**	**<.01**	**0.06**	**0.33**
Anxiety regressed on condition, controlling for perceived mental workload and intrusion time	-0.05	0.31	-0.17	.86	-0.66	0.56
Anxiety regressed on intrusion time, controlling for perceived mental workload and condition	-0.00	0.00	-0.24	.81	-0.00	0.00
Anxiety regressed on condition (total effects model), controlling for intrusion time	-0.04	0.31	-0.13	.90	-0.00	0.00

Indirect Effect and Significance Using Normal Theory						
	Effect	*SE*	*z*	*p*		
Sobel-Perceived mental workload	0.01	0.08	0.16	.88		
	Bootstrap Results for Indirect Effects				*Bootstrap CI*	
	Effect	*Boot SE*			*LL 95% CI*	*UL 95% CI*
Perceived mental workload	0.01	0.10			-0.15	0.24

Note. n = 112. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion. R^2 = .00, $F(2, 109) = 0.01$, p = .99

Therefore, although the mindfulness induction did significantly improve state mindfulness, given that the control induction also improved state mindfulness, these results fail to support Hypothesis 3.

Hypothesis 4a proposed that individuals who reported higher levels of mindfulness would complete a secondary task more quickly than those that reported lower levels of mindfulness. Results of a simple regression failed to support Hypothesis 4a. Specifically, when post-induction state mindfulness was entered as a predictor of time required to complete the SONA form, it was not significant (R^2 = .01, B = 5.09, $SE(B)$ = 5.86, β = .08, p = .39, $CI_{95\%}$ = [-6.54, 16.71]). Thus, state mindfulness was not a significant predictor of how quickly participants completed the SONA form. Additionally, an independent samples t-test failed to find significant group differences in time required to complete the SONA form between those who received the mindfulness induction (M = 80.51, SD = 36.40) and those who received the control induction (M = 71.55, SD = 40.72), $t(107) = 1.20$, p = .23. Thus, Hypothesis 4a remained unsupported.

Hypothesis 4b proposed that individuals who reported higher levels of mindfulness would report lower levels of perceived mental workload than those that reported lower levels of mindfulness. Further, a regression failed to find a significant relationship between post-induction state mindfulness and perceived mental workload (R^2 = .01, B = 0.16, SE(B) = 0.20, β = .08, p = .42, $CI_{95\%}$ = [-0.24, 0.56]), thus failing to support Hypothesis 4b. Moreover, results from an independent samples t-test failed to find significant group differences in perceived mental workload between those who received the mindfulness induction (M = 4.75, SD = 1.46) and those who received the control induction (M = 4.64, SD = 1.33), $t(108) = 0.40$, p = .69, thus Hypothesis 4b remained unsupported.

Table 6

Mediational Test of Interruption Condition Predicting Stress, Controlling for Intrusion Time

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)*	
					LL 95% CI	*UL 95% CI*
Direct and Total Effects						
Perceived mental workload regressed on condition, controlling for intrusion time	0.06	0.39	0.17	.87	-0.71	0.84
Perceived mental workload regressed on intrusion time, controlling for condition	0.00	0.00	0.49	.62	-0.00	0.01
Stress regressed on perceived mental workload, controlling for condition and intrusion time	**0.19**	**0.09**	**2.14**	**.03**	**0.01**	**0.37**
Stress regressed on condition, controlling for perceived mental workload and intrusion time	-0.31	0.44	-0.70	.49	-1.19	0.57
Stress regressed on intrusion time, controlling for perceived mental workload and condition	-0.00	0.00	-0.76	.45	-0.01	0.00
Stress regressed on condition (total effects model), controlling for intrusion time	-0.30	0.44	-0.67	.50	-1.17	0.58

Indirect Effect and Significance Using Normal Theory						
	Effect	*SE*	*z*	*p*		
Sobel-Perceived mental workload	0.01	0.08	0.15	.88		
	Bootstrap Results for Indirect Effects				*Bootstrap CI*	
	Effect	*Boot SE*			*LL 95% CI*	*UL 95% CI*
Perceived mental workload	0.01	0.10			-0.15	0.26

Note. n = 112. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion. R^2 = .00, $F(2, 109) = 0.01$, p = .99

Hypothesis 5a proposed that the moderating effect of mindfulness on the relationship between intrusions and perceived mental workload would carry through to the number of errors made, such that the mediated relationship between intrusions and number of errors made would be weaker when individuals reported higher levels of state mindfulness than those that do not. Results of a bootstrapped test for moderated mediation, controlling for intrusion time, failed to support Hypothesis 5a (Table 7). Intrusion condition did not significantly predict perceived mental workload (B = -1.19, $SE(B)$ = 1.70, p = .49, $CI_{95\%}$ = [-4.56, 2.19]). Similarly, state mindfulness did not significantly predict perceived mental workload (B = -0.30, $SE(B)$ = 0.70, p = .67, $CI_{95\%}$ = [-1.68,1.08]). The interaction between state mindfulness and intrusion condition also failed to significantly predict perceived mental workload (B = 0.33, $SE(B)$ = 0.46, p = .48, $CI_{95\%}$ = [-0.59, 1.24]). This suggested that there was no significant mediation or moderation in this model predicting errors, conclusions that were supported by the results for the index of moderated mediation (index = 0.15, SE = 0.53, $CI_{95\%}$ = [-0.43, 2.22]). Therefore, Hypothesis 5a was not supported.

Hypothesis 5b proposed that the moderating effect of mindfulness on the relationship between intrusions and perceived mental workload would carry through to anxiety, such that the mediated relationship between intrusions and anxiety would be weaker when individuals reported higher levels of state mindfulness. Hypothesis 5c proposed that the moderating effect of mindfulness on the relationship between intrusions and perceived mental workload would carry through to stress, such that the mediated relationship between intrusions and stress would be weaker when individuals reported higher levels of state mindfulness. Results of multiple bootstrapped tests for moderated mediation failed to support Hypotheses 5b and 5c. Specifically, results of a bootstrapped test for the index of moderated mediation, controlling for intrusion time,

failed to find significant evidence of state mindfulness as a moderator of the relationship between intrusion condition and perceived mental workload when predicting anxiety, thereby failing to find moderated mediation (Table 8; index = 0.06, *SE* = 0.10, $CI_{95\%}$ = [-0.08, 0.32]). A similar pattern of results was found when stress was the outcome variable (Table 9; index = 0.06, *SE* = 0.11, $CI_{95\%}$ = [-0.07, 0.34]). Together, these results fail to support Hypothesis 5b and Hypothesis 5c, and the role of state mindfulness as moderator of the mediated relationship between intrusion condition and the psychological strain outcomes of anxiety and stress.

Post Hoc Analyses

Given the failure of the proposed model to significantly predict outcomes of interest, and given that researchers argue *perceptions* of stressors, rather than the stressors alone, predict strain outcomes (Lazarus & Folkman, 1984), I tested an additional model (Figure 4) in which perceived intrusions partially mediated the relationship between intrusion condition and strain outcomes. Further, when examining the hypothesis testing results, it became apparent that controlling for the length of the intrusion was not necessary for strain outcomes, and also may have been eliminating meaningful variance. Therefore, when examining these relationships, no control variables were used

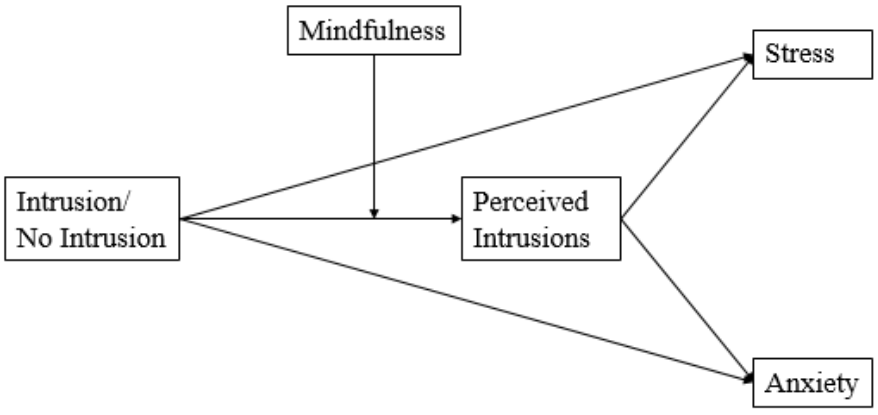

Figure 4. Post hoc model to examine the effects of perceived intrusions as a mediator between intrusion condition and strain outcomes.

Table 7

Moderated Mediational Test of Intrusion Condition Predicting Errors, Controlling for Time

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)*	
					LL 95% CI	*UL 95% CI*
Direct and Total Effects						
Perceived mental workload regressed on condition	-1.19	1.70	-0.70	.49	-4.56	2.19
Perceived mental workload regressed on state mindfulness	-0.30	0.70	-0.43	.67	-1.68	1.08
Perceived mental workload regressed on the interaction of mindfulness and condition	0.33	0.46	0.71	.48	-0.59	1.24
Perceived mental workload regressed on intrusion time	0.00	0.00	0.44	.66	-0.00	0.01
Errors regressed on perceived mental workload, controlling for condition and intrusion time	0.46	0.87	0.52	.60	-1.27	2.18
Errors regressed on intrusion time, controlling for perceived mental workload and intrusion condition	0.02	0.02	1.09	.28	-.02	0.07
Errors regressed on condition, controlling for perceived mental workload	-4.12	3.42	-1.20	.23	-10.91	2.67

Bootstrapped Indirect Effect at Different Levels of Moderator				
			Bootstrap CI	
	Effect	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload (low mindfulness)	-0.10	0.53	-1.93	0.49
Perceived mental workload (mean mindfulness)	-0.00	0.44	-1.02	0.83
Perceived mental workload (high mindfulness)	0.10	0.58	-0.60	2.15

	Bootstrap Results for Index of Moderated Mediation		*Bootstrap CI*	
	Index	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload	0.15	0.53	-0.43	2.22

Note. n = 111. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion. $\boldsymbol{R^2 = .07, F(3, 107) = 2.71, p < .05}$

Table 8

Moderated Mediational Test of Intrusion Condition Predicting Anxiety, Controlling for Time

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)*	
					LL 95% CI	*UL 95% CI*
Direct and Total Effects						
Perceived mental workload regressed on condition	-1.19	1.54	-0.77	.44	-4.24	1.87
Perceived mental workload regressed on state mindfulness	-0.30	0.63	-0.48	.64	-156	0.95
Perceived mental workload regressed on the interaction of mindfulness and condition	0.33	0.42	0.78	.44	-0.50	1.16
Perceived mental workload regressed on intrusion time	0.00	0.00	0.34	.73	-0.01	0.01
Anxiety regressed on perceived mental workload, controlling for condition and intrusion time	**0.19**	**0.07**	**2.86**	**<.01**	**0.06**	**0.33**
Anxiety regressed on condition, controlling for perceived mental workload and intrusion condition	-0.05	0.31	-0.17	.87	-0.67	0.57
Anxiety regressed on intrusion time, controlling for perceived mental workload	-0.00	0.00	-0.24	.81	-0.00	0.00

Bootstrapped Indirect Effect at Different Levels of Moderator				
			Bootstrap CI	
	Effect	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload (low mindfulness)	-0.04	0.11	-0.30	0.16
Perceived mental workload (mean mindfulness)	-0.00	0.09	-0.17	0.22
Perceived mental workload (high mindfulness)	0.04	0.12	-0.13	0.36

	Bootstrap Results for Index of Moderated Mediation		*Bootstrap CI*	
	Index	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload	.06	0.10	-0.08	0.32

Note. n = 111. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion. R^2 = .07, $F(3, 107) = 2.55$, p = .06

Table 9

Moderated Mediational Test of Interruption Condition Predicting Stress, Controlling for Time

					Confidence Interval (CI)	
Variable	*B*	*SE*	*t*	*p*	*LL 95% CI*	*UL 95% CI*
Direct and Total Effects						
Perceived mental workload regressed on condition	-1.19	1.70	-0.77	.44	-4.24	1.87
Perceived mental workload regressed on state mindfulness	-0.30	0.70	-0.48	.64	-1.56	0.95
Perceived mental workload regressed on the interaction of mindfulness and condition	0.33	0.46	0.78	.64	-0.50	1.16
Perceived mental workload regressed on intrusion time	0.00	0.00	0.34	.73	-0.01	0.01
Stress regressed on perceived mental workload, controlling for condition and intrusion time	**0.19**	**0.09**	**2.19**	**.03**	**0.02**	**0.36**
Stress regressed on intrusion time, controlling for perceived mental workload and intrusion condition	-0.00	0.00	-0.89	.38	-0.01	0.00
Stress regressed on condition, controlling for perceived mental workload	-0.32	0.38	-0.85	.40	-1.08	0.43

Bootstrapped Indirect Effect at Different Levels of Moderator			*Bootstrap CI*	
	Effect	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload (low mindfulness)	-0.04	0.12	-0.34	0.14
Perceived mental workload (mean mindfulness)	-0.00	0.10	-0.18	0.23
Perceived mental workload (high mindfulness)	0.04	0.12	-0.11	0.42

Bootstrap Results for Index of Moderated Mediation			*Bootstrap CI*	
	Index	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload	.06	0.10	-0.07	0.34

Note. n = 111. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = Upper limit. Condition: 1 = intrusion and 2 = no intrusion. R^2 = .05, $F(3, 107) = 1.85$, p = .14

Results suggest that, overall, this model (Table 10) accounted for 10% of the variance in anxiety, $F(2,91) = 5.17$, $p = .01$. Specifically, perceived intrusions ($B = 0.36$, $SE(B) = 0.11$, $p = .002$), but not intrusion condition ($B = 0.29$, $SE(B) = 0.23$, $p = .20$) had a significant main effect on anxiety. Further, this model explained 18% of the variance in perceived intrusions, $F(3,90) = 6.56$, $p < .001$. There was a main effect of intrusion condition ($B = -0.81$, $SE(B) = 0.19$, $p < .001$) on perceived intrusions. State mindfulness did not, however, significantly moderate the relationship ($B = -0.30$, $SE(B) = 0.30$, $p = .31$). Therefore, although there was not significant moderated mediation, there was evidence for significant distal mediation of intrusion condition on anxiety through perceived intrusions, such that individuals who received the secondary task as an intrusion reported more anxiety due to an increase in perceived intrusions as compared to those who were not interrupted.

Similarly, results suggest that, overall, this model (Table 11) accounted for 18% of the variance in stress, $F(2,91) = 10.00$, $p < .001$. Specifically, perceived intrusions ($B = 0.57$, $SE(B) = 0.13$, $p < .001$), but not intrusion condition ($B = 0.42$, $SE(B) = 0.26$, $p = .11$) had a significant main effect on stress. Given that only the outcome changed, the portion of the model predicting perceived intrusions remained the same as before. Therefore, although there was not significant moderated mediation, there was evidence for significant distal mediation of intrusion condition on stress through perceived intrusions, such that individuals who received the secondary task as an intrusion reported more stress due to an increase in perceived intrusions as compared to those who were not interrupted.

Table 10

Post Hoc Moderated Mediation Test of Interruption Condition Predicting Anxiety

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)*	
					LL 95% CI	*UL 95% CI*
Direct and Total Effects						
Perceived intrusions regressed on condition	**-0.81**	**0.19**	**-4.16**	**<.001**	**-1.20**	**-0.42**
Perceived intrusions regressed on state mindfulness	0.20	0.15	1.31	.20	-0.10	0.49
Perceived intrusions regressed on the interaction of mindfulness and condition	-0.30	0.30	-1.01	.31	-0.90	0.29
Anxiety regressed on perceived intrusions	**0.36**	**0.11**	**3.21**	**.002**	**0.14**	**0.58**
Anxiety regressed on condition	0.29	0.23	1.28	.20	-.16	0.74

Bootstrapped Indirect Effect at Different Levels of Moderator				
			Bootstrap CI	
	Effect	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived intrusions (low mindfulness)	**-0.22**	**0.13**	**-0.56**	**-0.03**
Perceived intrusions (mean mindfulness)	**-0.29**	**0.11**	**-0.57**	**-0.11**
Perceived intrusions (high mindfulness)	**-0.36**	**0.13**	**-0.70**	**-0.15**

	Bootstrap Results for Index of Moderated Mediation		*Bootstrap CI*	
	Index	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload	-0.11	0.10	-0.34	0.06

Note. n = 94. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion.. **R^2 = .10, F(2, 91) = 5.16, p = .01**

Table 11

Post Hoc Moderated Mediation Test of Interruption Condition Predicting Stress

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)*	
					LL 95% CI	*UL 95% CI*
Direct and Total Effects						
Perceived intrusions regressed on condition	**-0.81**	**0.19**	**-4.16**	**<.001**	**-1.20**	**-0.42**
Perceived intrusions regressed on state mindfulness	0.20	0.15	1.31	.20	-0.10	0.49
Perceived intrusions regressed on the interaction of mindfulness and condition	-0.30	0.30	-1.01	.31	-0.90	0.29
Stress regressed on perceived intrusions	**0.57**	**0.13**	**4.47**	**<.001**	**0.32**	**0.82**
Stress regressed on condition	0.42	0.26	1.63	.11	-0.09	0.94

Bootstrapped Indirect Effect at Different Levels of Moderator				
			Bootstrap CI	
	Effect	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived intrusions (low mindfulness)	**-0.35**	**0.19**	**-0.80**	**-0.06**
Perceived intrusions (mean mindfulness)	**-0.46**	**0.15**	**-0.83**	**-0.21**
Perceived intrusions (high mindfulness)	**-0.58**	**0.19**	**-1.04**	**-0.27**

	Bootstrap Results for Index of Moderated Mediation		*Bootstrap CI*	
	Index	*Boot SE*	*LL 95% CI*	*UL 95% CI*
Perceived mental workload	-0.17	0.16	-0.52	0.13

Note. n = 94. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion.. $\mathbf{R^2 = .18, F(2, 91) = 10.00, p < .001}$

Examining these results, it seemed that not only was it pertinent to analyze the effects of perceived intrusions without controlling for the time required to complete the interruption, but that it may be important to examine time as an additional moderator within this model. In their transactional model of stress, Lazzarus and Folkman (1984) suggest that individuals experience

strain outcomes, like stress and anxiety, if they perceive their resources to be inadequate in the face of the demands of a stressor. For the individuals who were intruded upon, this perception might have overshadowed the perceived resource of mindfulness, thus altering the overall perceptions of the intrusion, and ultimately, the strain outcomes of stress and anxiety. Specifically, the length of time required to complete the secondary task (SONA form) may have placed such a great demand on individuals when it was given as an intrusion, that the potential resource of mindfulness were actually limited.

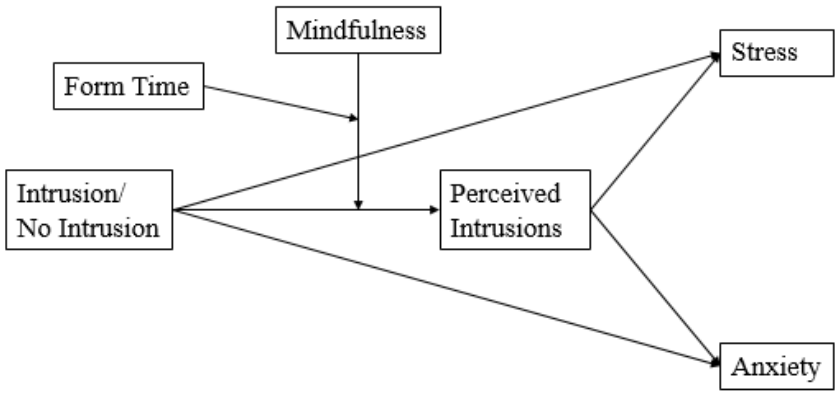

Figure 5. Post hoc model to examine the effects of time as an additional moderator and perceived intrusions as a mediator between intrusion condition and strain outcomes.

Overall, this model (Table 12) significantly explained 10% of the variance in anxiety, $F(2, 90) = 5.22$, $p = .01$. Specifically, perceived intrusions predicted anxiety ($B = 0.36$, $SE(B) = 0.11$, $p < .01$). This model also significantly predicted perceived intrusions, accounting for 25% of the variance, $F(7,85) = 4.07$, $p = .001$. There was a significant main effect of intrusion condition on perceived intrusions ($B = 5.73$, $SE(B) = 2.67$, $p = .03$), supporting mediation of perceived intrusions as an explanatory mechanism of the relationship between intrusions and anxiety. This effect must be interpreted with caution, however, given the significant three-way interaction, suggesting that intrusion condition, state mindfulness, and form time interacted to predict perceived intrusions ($B = 0.02$, $SE(B) = 0.01$, $p = .04$). The nature of this moderation is

such that when individuals completed the form quickly, they reported more perceived intrusions only if they had high levels of state mindfulness and received the form as an intrusion, rather than after primary task completion. However, if participants completed the form slowly, they consistently reported higher levels of perceived intrusions if they had higher levels of mindfulness, and this effect was exaggerated if they received the form after task completion.

These effects carried through, such that there was a significant indirect effect, via perceived intrusions, of intrusion condition on anxiety that was moderated by both form time and mindfulness (Table 13). Specifically, considering solely the indirect effect, individuals who received the SONA form as an intrusion reported more anxiety than those who received the form after completing the primary task, as was found in the previous model. This significant indirect relationship did not apply for individuals who were low on mindfulness and completed the form quickly. This pattern of results may suggest that the initially hypothesized effects of intrusion condition on anxiety were present, but too distal to find a significant effect without identification of the mediator of perceived intrusions. Further, this indirect effect was present only for individuals who were either engaged with the task (took longer to complete the secondary task) or were paying attention (were more mindful). Thus, this post hoc analysis lends some support to the initially hypothesized model that intrusion condition affects anxiety, although it does so in a distal manner. It also further explores the results from the previous post hoc analysis, suggesting that state mindfulness does moderate the effects of objective intrusions on perceived intrusions, but only when one considers the moderating effects of form time.

Table 12

Post Hoc Moderated Moderated Mediation Test of Intrusion Condition Predicting Anxiety

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)* *LL 95% CI*	*Confidence Interval (CI)* *UL 95% CI*
Direct and Total Effects						
Perceived intrusions regressed on condition	**5.73**	**2.67**	**2.15**	**.03**	**0.43**	**11.03**
Perceived intrusions regressed on state mindfulness	**2.30**	**1.10**	**2.09**	**.04**	**0.12**	**4.47**
Perceived intrusions regressed on the intrusion condition X state mindfulness	**-1.62**	**0.72**	**-2.26**	**.03**	**-3.05**	**-0.19**
Perceived intrusions regressed on form time	0.09	0.05	187	.06	-0.01	0.19
Perceived intrusions regressed on intrusion condition X form time	**-0.07**	**0.03**	**-2.29**	**.03**	**-0.14**	**-0.01**
Perceived intrusions regressed on state mindfulness X form time	-0.02	0.01	-1.76	.08	-0.05	0.00
Perceived intrusions regressed on intrusion condition X state mindfulness X form time	**0.02**	**0.01**	**2.10**	**.04**	**0.00**	**0.03**
Anxiety regressed on perceived intrusions	**0.36**	**0.11**	**3.23**	**.002**	**0.14**	**0.59**
Anxiety regressed on condition (total effects model), controlling for perceived intrusions	0.28	0.23	1.22	.22	-0.18	0.74

Note. n = 93, . Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion.. $\boldsymbol{R^2 = .10, F(2, 90) = 5.22, p = .01}$

Table 13

Post Hoc Conditional Indirect Effects of Intrusion Condition on Anxiety at Different Levels of the Moderators in a Moderated Mediation Test

			Confidence Interval	
Mindfulness	Speed	Indirect Effect	LL 95% CI	UL 95% CI
Low	Fast	0.05	-0.25	0.32
Low	**Slow**	**-0.53**	**-1.22**	**-0.16**
High	**Fast**	**-0.41**	**-0.89**	**-0.10**
High	**Slow**	**-0.32**	**-0.83**	**-0.04**

Note. n = 93. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion.

These results were mirrored when examining relationships with perceived stress. Overall, this model (Table 14) significantly explained 18% of the variance in stress, $F(2, 90) = 9.98$, $p < .001$. Specifically, intrusion condition did not directly predict stress ($B = 0.41$, $SE(B) = 0.26$, $p = .12$), but perceived intrusions did ($B = 0.57$, $SE(B) = 0.13$, $p < .001$). The main effect and three-way interaction predicting perceived intrusions were all the same as in the previously discussed model, given that only the relationships with the outcome changed. The effects of the three-way interaction again carried through as an indirect effect, suggesting that intrusion condition significantly predicted stress through changes in perceived intrusions. Specifically, considering solely the indirect effects (Table 15), individuals who received the SONA form as an intrusion reported more stress than those who received the form after completing the primary task. This significant indirect relationship did not apply for individuals who were low on mindfulness and completed the form quickly. This pattern of results may suggest that individuals who were not paying attention and did not care about task completion had different perceptions of the intrusion that did not carry over to increased stress.

Table 14

Post Hoc Moderated Moderated Mediation Test of Interruption Condition Predicting Stress

Variable	*B*	*SE*	*t*	*p*	*Confidence Interval (CI)*	
					LL 95% CI	*UL 95% CI*
Direct and Total Effects						
Perceived intrusions regressed on condition	**5.73**	**267**	**2.05**	**.03**	**0.43**	**11.03**
Perceived intrusions regressed on state mindfulness	**2.30**	**1.10**	**2.09**	**.04**	**0.12**	**4.47**
Perceived intrusions regressed on the intrusion condition X state mindfulness	**-1.62**	**0.72**	**-2.26**	**.03**	**-3.05**	**-0.19**
Perceived intrusions regressed on form time	0.09	0.05	1.87	.07	-0.01	0.19
Perceived intrusions regressed on intrusion condition X form time	**-0.07**	**0.03**	**-2.29**	**.02**	**-0.14**	**-0.01**
Perceived intrusions regressed on state mindfulness X form time	-0.02	0.01	-1.76	.08	-0.05	0.00
Perceived intrusions regressed on intrusion condition X state mindfulness X form time	**0.02**	**0.01**	**2.10**	**.04**	**0.00**	**0.03**
Stress regressed on perceived intrusions	**0.57**	**0.13**	**4.47**	**<.001**	**0.32**	**0.83**
Stress regressed on condition (total effects model), controlling for perceived intrusions	0.41	0.26	1.58	.12	-0.11	0.93

Note. n = 93. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion. $\boldsymbol{R^2 = .18, F(2, 90) = 9.98, p < .001}$

Table 15

Post Hoc Conditional Indirect Effects of Intrusion Condition on Stress at Different Levels of the Moderators in a Moderated Mediation Test

			Confidence Interval	
Mindfulness	Speed	Indirect Effect	LL 95% CI	UL 95% CI
Low	Fast	0.08	-0.37	0.49
Low	**Slow**	**-0.84**	**-1.63**	**-0.32**
High	**Fast**	**-0.64**	**-1.18**	**-0.15**
High	**Slow**	**-0.51**	**-1.31**	**-0.01**

Note. n = 93. Bootstrap sample size = 5,000. LL = lower limit; CI = confidence interval; UL = upper limit. Condition: 1 = intrusion and 2 = no intrusion.

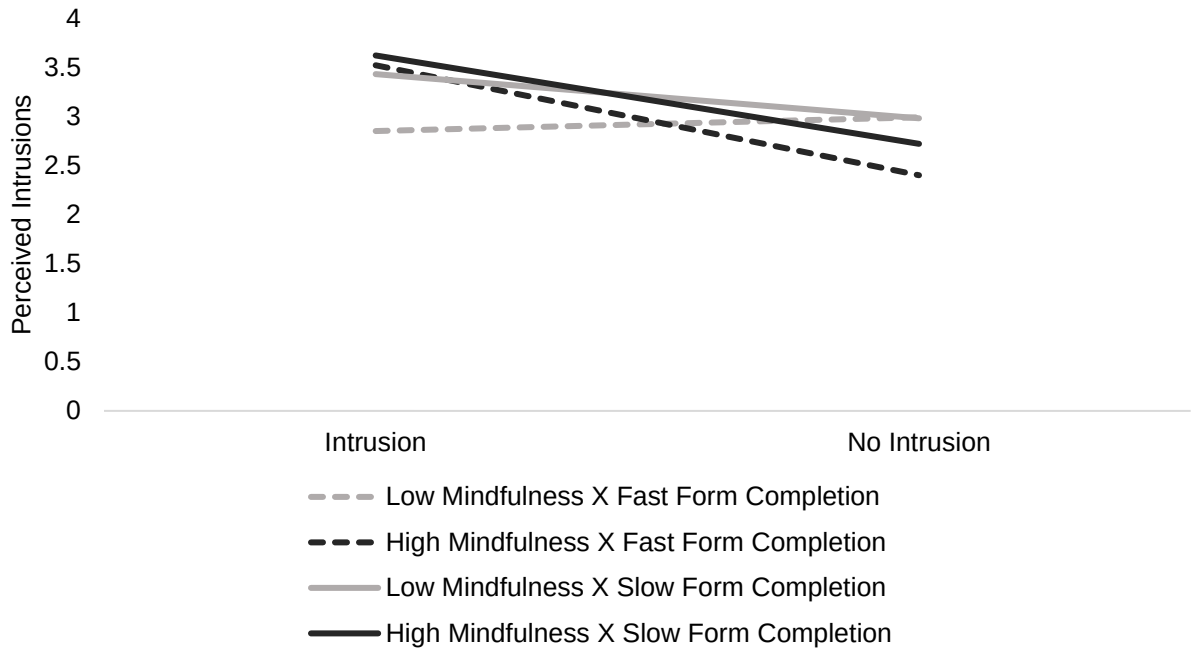

Figure 6. Post hoc three-way interaction of form completion time moderating the moderating effects of state mindfulness on the relationship between intrusion condition and perceived intrusions. *Note:* Slopes were made using +/- one standard deviation of state mindfulness and form completion time.

Lastly, to examine whether the induction conditions may have had differential effects on state mindfulness over time, I conducted a repeated measures ANOVA. Specifically, although the mindfulness induction did not result in significantly higher levels of state mindfulness than the control induction immediately following the inductions, it may have resulted in a longer lasting effect. Results (see Figure 7) suggest that there was a significant main effect of time point on state mindfulness, $F(2,182) = 28.34$, $p < .001$. There was not, however, a significant interaction between induction condition and time, $F(2, 182) = 1.25$, $p = .29$. Specifically, pairwise results suggest that at baseline, individuals in the mindfulness induction group did not differ in state mindfulness ($M = 3.01$, $SD = 0.72$) from those in the control induction ($M = 3.16$, $SD = 0.77$). State mindfulness increased for both groups immediately following the induction ($p < .001$), but it did not differ between those in the mindfulness induction ($M = 3.64$, $SD = 0.66$) and those in the control induction ($M = 3.64$, $SD = 0.67$). State mindfulness then decreased significantly for all groups ($p < .001$) but did not differ at this final time point between those in the mindfulness induction ($M = 3.29$, $SD = 0.69$) and those in the control induction ($M = 3.20$, $SD = 0.72$). Although these results do not support differences in state mindfulness over time, based on the inductions, they do, however, suggest that the effects of the induction had an effect that lasted the duration of the study, such that final reports of state mindfulness were significantly higher than baseline reports of state mindfulness ($p = .047$), but were significantly lower than post-induction state mindfulness ($p < .001$).

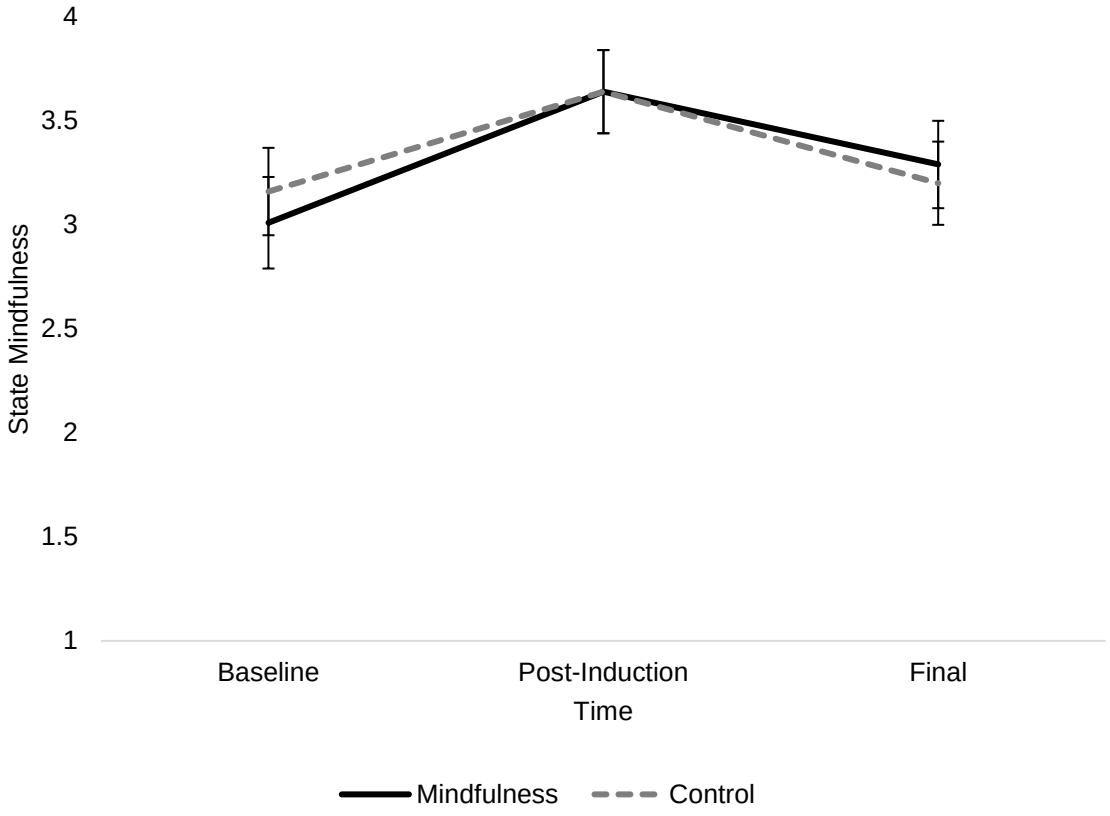

Figure 7. Post hoc examination of the effects of induction condition on state mindfulness over time *Note:* Error bars represent two standard errors.

CHAPTER FOUR

DISCUSSION

Overall, results of the hypothesis testing failed to support the relationships between objective intrusions, perceived mental workload, mindfulness, performance, and strain. There was no main effect of intrusion condition on errors, anxiety, or stress. Perceived mental workload was not found to be a significant mediator of the relationship between intrusion condition and errors, stress, or anxiety. However, results did suggest that perceived mental workload significantly predicted both anxiety and stress. State mindfulness failed to moderate the relationship between intrusion condition and perceived mental workload. Further, those that received the mindfulness induction did not report higher levels of state mindfulness than those who received the control induction. However, post hoc analyses suggest that perceptions of intrusions significantly mediated the relationship between intrusion condition and both indicators of psychological strain (i.e., anxiety and stress). This mediation was also subject to a three-way interaction, such that the indirect effect of intrusion condition on anxiety and strain is only present if participants were paying attention (not low in mindfulness) and engaged with the task (took longer to complete the SONA form). Specifically, after taking into consideration this three-way interaction, and the mediation role of perceived intrusions, these post hoc analyses suggest that receiving the SONA form as an intrusion resulted in more anxiety and stress than if the form was received after primary task completion. This may suggest that the initial hypothesized relationship between intrusions and strain outcomes had merit, but were overshadowed by the moderating effects of mindfulness and time required to complete the SONA form. Further, post

hoc results also suggest that both the mindfulness and control inductions resulted in similar changes in state mindfulness that peaked immediately following the induction but remained significantly higher than baseline at the end of the study.

Looking at the results of the hypothesized relationships highlights certain conclusions and limitations of this study. Specifically, I first hypothesized that individuals who experienced an intrusion during a task would make significantly more errors than those who were not interrupted. Although intrusion condition did significantly predict the number of errors, this relationship failed to be significant after accounting for the duration of the intrusion. These results are, to an extent, in line with findings of Czerwinski, Cutrell, and Horvitz (2000), who found that interruptions were more disruptive and caused more delays and performance decrements in tasks that were search-driven, and that were not cognitively taxing. Given that the primary task was a cognitively engaging and burdensome task, the finding that intrusions may not have affected performance is less surprising. However, these results may also indicate that intrusions influence performance only to the extent that they reduce the amount of time available to complete the task, or, and perhaps more likely, that the cognitive burden of the intrusion is too closely linked to the duration of the intrusion to be able to statistically control for this effect. Future studies should examine this hypothesized relationship further by experimentally, rather than statistically, controlling the length of the intrusion, thereby allowing for the isolation of cognitive burden from time required for the intrusion.

I also hypothesized that the experience of an intrusion would significantly affect psychological strain. This was also not supported. These findings, however, are in line with Lazarus and Folkman's (1984) transactional model of stress, which suggests that it is the appraisals of stressors, rather than the stressors alone, that predict strain outcomes. This would

suggest that the degree to which individuals perceived the intrusion as a stressor should be more predictive of strain outcomes than their objective experience of an intrusion. The post hoc analyses lend support to this notion, but future studies should directly address this limitation by further exploring the potentially mediating relationship of the stressor appraisal of intrusions on the relationship between intrusions and subjective strain outcomes.

In addition to the direct relationship between intrusion condition and errors and strain, I hypothesized that perceived mental workload would partially mediate these relationships. Although perceived mental workload did significantly predict psychological strain and errors, it was, in fact, unrelated to intrusion condition as well as the number of errors. Again, the transactional model of stress (Lazarus & Folkman, 1984) would suggest that it should be the subjective appraisal of the intrusion that would predict strain outcomes, more so than the objective stressor. Certainly perceived mental workload is, to a degree, an appraisal of stress, it is not, however, an appraisal of the specific stressor of the intrusion, therefore limiting its ability to mediate the relationship between objective intrusions and subjective strain outcomes. This suggests there is likely a more complex relationship that exists between intrusions and outcomes of interests that should be explored through more distal mediation models with multiple mediators to sequentially explain the complex nature of how interruptions affect performance and strain outcomes.

I also hypothesized that individuals who received a short mindfulness induction would report more state mindfulness than their peers who received only a control intervention. This hypothesis was also not supported; however, results suggested that both conditions reported significantly more mindfulness than baseline. These findings suggest that, even after removing participants from analysis who were not paying attention to the induction videos, individuals

who received a twenty-five minute mindfulness induction were no more mindful than those who received a control induction. This may speak to the quality of the state mindfulness measure, suggesting that it captures more than true mindfulness, or to the quality of the control induction, suggesting that it provides mindfulness despite attempting to induce mind wandering. Future studies should explore potential reasons for these findings, perhaps examining the mode of induction (digital, as was the case for this study, versus in-person inductions), various qualities of the induction (feedback from instructor, specific exercises, provision of specific information about mindfulness), as well as other potential methods of measuring state mindfulness.

I also hypothesized that mindfulness would directly influence the speed with which individuals completed the SONA form. This hypothesis was not supported, in that there was no direct effect of mindfulness on secondary task speed, nor was there a relationship between reported state mindfulness and secondary task speed. State mindfulness is thought to make one more aware. Perhaps in some people, this translated to increased attention to detail, which actually made them take more time on tasks. Future research should continue to explore this to determine relevant individual differences that can elucidate this finding.

Similarly, I hypothesized that individuals who reported higher levels of mindfulness would report lower levels of perceived mental workload. This hypothesis was not supported, in that neither post-induction state mindfulness nor induction condition predicted perceived mental workload. Perhaps post-induction mindfulness was contaminated by perceived mindfulness, not actual mindfulness ability, as shown by the lack of a significant difference between mindfulness conditions on post-induction state mindfulness. This could suggest a limited criterion validity of this measurement. Or perhaps, the control induction was too strong.

Lastly, results failed to support the hypothesis that mindfulness would moderate the relationship between intrusion condition and perceived mental workload, and that this moderation effect would carry through to errors and strain. This stands in contrast to recent findings that mindfulness interventions can change and improve individuals' perceptions of job characteristics and demands (Puolakanaho, Kinnunen, & Lappalainen, 2016). Specifically, Puolakanaho and colleagues (2016) found that positive changes in perceptions of workload were experienced by individuals in either the mindfulness condition (an eight-week intervention) and the control condition, but that the change was significantly greater for those in the mindfulness condition. The discrepancy between Puolakanho and colleagues' findings and those of the current study might be the strength of the interventions (eight-weeks versus twenty-five minutes) as well as the level of analysis for workload (overall job workload versus perceived mental workload for a single task). Future research should compare different mindfulness interventions on workload perceptions to identify how much training is necessary to achieve desired changes in perceived workload, and whether those changes differ based on the level of analysis (e.g., mental workload versus overall workload).

Theoretical and Practical Applications

Together, the results of the initial hypothesis testing and the post hoc analyses contribute to both the interruptions and the strain literature. These results suggest that the theory of mental workload may not be able to explain the relationship between intrusions and performance or strain outcomes. However, in line with the transactional model of stress (Lazarus & Folkman, 1984), the perceptions of intrusions acted as a mediator between objective intrusions and strain outcomes such as stress and anxiety. Thus, when considering the negative strain-based consequences of interruptions, the field must now move beyond models that are rooted in

objective experience such as frequency and timing to incorporate perceptions of those interruptions in order to truly capture the effects of intrusions.

More specifically, the case of intrusions and strain outcomes may be an example of distal mediation, suggesting that there may be other, similar stressors that are simply too distal to directly result in strain outcomes. Returning to the transactional model of stress (Lazarus & Folkman, 1984), which posits that stimuli go through two sets of appraisals (relevance and severity) before resulting in stress, one sees a theoretical case for distal mediation. Specifically, Shrout and Bolger (2002) suggest that distal mediation occurs when a causal effect occurs so far upstream in a chain of related events that the effect size of the relationship between the cause and eventual outcome of interest is too small to be detected, except through the indirect effects via the mediators. The transactional model of stress (Lazarus & Folkman, 1984) has two cognitive processes occurring between a stressor and the experience of stress, which itself is an instance of distal mediation. The results of my post hoc analyses support such distal mediation arguments given that there was no significant direct relationship between intrusion condition and the strain outcomes.

These post-hoc analyses also found a significant three-way interaction between the time required to complete the SONA form, state mindfulness, and intrusion condition predicting perceived intrusions which carried through to predict the strain outcomes of anxiety and stress. Specifically, these results suggest that the mediated effect of intrusion condition on strain outcomes was present only if participants were actively engaged and paying attention to the task. Participants who were low on mindfulness and completed the SONA form quickly may have been minimally motivated to perform well, and thus, intrusion condition did not result in

differential effects on strain outcomes through perceived intrusions because they did not perceive the intrusion as a stressor.

In addition to the contribution to the stress and interruptions literature, this study adds to the mindfulness literature in the form of unanswered questions. From a practical perspective, the short mindfulness induction did improve reported mindfulness so organizations wishing to improve mindfulness in their employees can utilize shorter inductions. Further, post hoc analyses suggest that although reports of state mindfulness decreased following the inductions, they remained higher at the end of the study than they were at baseline, suggesting that the effects may have a lingering effect. However, given that reports of state mindfulness increased regardless of induction, one is left wondering how valid are the current measures of state mindfulness? If the measure was sound, however, this begs the question of what exactly is necessary for a mindfulness induction? Do individuals simply have to feel as if they are meditating to experience increased mindfulness? The body of literature on mindfulness is relatively novel, resulting in many more questions than answers. The results of this study help only to expand the pool of questions, arguably a valuable exercise itself, for such a young field.

To date, most analyses of workplace intrusions have relied upon objective measures, such as overall time or frequency of interruptions (e.g., Alvarez & Coiera, 2005; Chisholm, Collison, Nelson, & Cordell, 2008; Jackson, Dawson, & Wilson, 2003). These metrics are resource intensive and thus, not feasible for many managers, administrators, or consultants who seek to examine the effects of intrusions in their workplace. However, results from this study suggest that these methods may not be as fruitful as surveying the perceptions of intrusions. A simple four item measure (Fletcher, Potter, & Telford, 2016) may be all that is necessary to rapidly

capture the negative effects of intrusions in the workplace, by targeting more proximal predictors (perceptions) rather than the more distal predictor of the objective intrusion.

General Limitations

Overall, this study faced several limitations that could partially explain the lack of significant results of hypothesis testing. Perhaps most glaringly, the mindfulness induction failed to induce a higher level of state mindfulness than the control induction, as both groups significantly improved from baseline levels. This could be due to the mode of induction provision (digital rather than in person), the strength of the control induction, or demand characteristics of the participants. Specifically, due to the face validity of the mindfulness questionnaire and the mindfulness knowledge test and open-ended questions that all participants received, participants may have reacted to the experimental environment (Shadish, Cook, & Campbell, 2001). These questions may also have genuinely induced a mindful state, more in line with Langer's (1997) notion of mindfulness, by requiring the participants to think critically about their own thought processes and experiences. The control induction was designed to promote mind wandering, but it is possible that the time participants spend in the training actually made them think about their thought processes and experiences and thus, they truly did become more mindful.

Additionally, this study is limited by the design, in that the intrusion length was not consistent across participants. This was part of the design of the experiment as there was no feasible way to create a set time for form completion across participants while maintaining the integrity of the deception. Therefore, this difference in the length of intrusion, when controlled for, may have also eliminated meaningful variance in the dependent variable that was significantly related to both intrusion condition and the length of the intrusion.

Lastly, this study may have benefited from a more ecologically valid examination of the effects of mindfulness on the relationship between intrusions, mental workload, and performance and strain. By conducting this study in the field, I may have been able to capitalize on true engagement with the task at hand, as well as the intrusion, perhaps magnifying the effect of mindfulness to a point of significance. Future studies should address these methodological concerns when further exploring these relationships.

Conclusion

Overall, this study failed to find consistently significant results, thereby failing to support the hypothesized relationship between intrusions, mental workload, mindfulness, and performance as well as the strain outcomes of anxiety and stress. Although the mindfulness induction significantly improved state mindfulness, the control induction also improved state mindfulness. Further, mindfulness did not buffer against the effects of intrusion on mental workload. Mental workload, however, was found to be a significant predictor of both anxiety and stress. Post hoc analyses, however, suggest that it is important to look beyond the simple objective experience of an intrusion, toward the subjective experience of that intrusion for predictive validity. Specifically, this study provided evidence for mediation of the relationship between intrusion condition and psychological strain through perceptions of interruptions, for participants that were high on mindfulness or were actively engaged with the intrusion as indicated by more time spent completing the form.

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APPENDICES

Appendix A: Script of task training

Hello, I am here to train you on how to do the task you will be asked to do in a few minutes. You will be asked to sort this deck of 60 cards so each row contains only one color and colors are sorted alphabetically. You will also have to sort the cards based on their numbers, so that each column only has 1 number and so that the numbers go in the following order: 1, 2, 3, 4, 5, 5, 4, 3, 2, 1. You will also need to make sure that there are no same shapes next to each other in the columns or rows. You will also need to make sure that the special cards are in their specific spots. Once those criteria have been met, you will remove certain cards. Now we will start the training by getting familiar with the cards, and then we will walk through a strategy of how to sort the cards efficiently. Finally, you will be given a chance to practice for sixty seconds. Each card in this deck has a different shape or set of shapes, with different shapes, color and number. The different colors are blue, brown, green, grey—which for our purposes we will spell G-R-E-Y, red and yellow. The different numbers are one, two, three four, and five. The different shapes are lightning bolts, triangles, raindrops, stars, flowers, and moons. Not every shape is represented equally in each color or each number. The final map will have a specific order, but there is no pattern to the shapes, other than the fact that there will be no two same shapes touching. The most efficient method for sorting these cards according to the task is to begin by creating six piles based on color, like this. These piles can then be expanded to thirty piles by number like this. Then, working your way down, expand them to the full row of ten cards, starting with blue. Make sure your mat has the blue lightning bolt in the top left corner, and that the blue for of stars is in the fourth column from the left. Make sure that there are not any two same shapes next to each other in this row. When you move onto brown, make sure there aren't two same shapes touching each other in this row, but also that they are not touching the blue cards of the same

shape, like this. Fix problems as you move on. Continue this process for green, then grey, which remember, you are spelling G-R-E-Y, so it will come after green. When you move onto red, make sure that the red two of lightning bolts is in the second column from the left. When you move on to yellow, be sure you have the yellow one of stars in the bottom left corner like this. You will then be asked to remove some cards, they will be listed in the checklist you may be given. They will be the third, fifth, sixth, and eight cards in the blue row the third and eight cards in the brown row, and the fourth, fifth, sixth, and seventh cards in the yellow row. Be sure you use your checklist to check of each step as you complete it, and to be sure it is true in your final map. When you are done with the task, tell the experimenter and he or she will ask you if you want to change anything. Go over your checklist once more and be sure you have done everything. If you have a mistake, this is your last chance to fix it. If you don't have a mistake, tell the experimenter you are sure that you are finished. Go ahead and take the next minute to get yourself familiar with the cards. Try searching through the deck, maybe try the first steps of sorting. The deck will be reshuffled, or you will be provided with a new, shuffled deck before you start your task.

[1 minute of card familiarization]

OK time is up, please set the deck down. You have learned about the cards. You have learned some trick of how to sort them according to the task, and you have had a chance to familiarize yourself with the actual cards. Good luck on the task! I'm sure you will do well, especially after this training.

Appendix B: Key of correct placement for primary task

	1	2	3	4	5	5	4	3	2	1
Blue	Lighting	Triangle	EMPTY	Star	EMPTY	EMPTY	Lighting	EMPTY	Star	Flower
Brown	Flower	Drop	EMPTY	Lighting	Star	Lighting	Triangle	EMPTY	Triangle	Star
Green	Moon	Star	Drop	Moon	Flower	Star	Drop	Triangle	Flower	Lighting
Grey	Drop	Flower	Triangle	Drop	Lightning	Moon	Flower	Star	Lighting	Moon
Red	Triangle	Lightning	Star	Flower	Moon	Flower	Triangle	Lightning	Moon	Drop
Yellow	Star	Moon	Lightning	Moon	EMPTY	EMPTY	Star	Flower	Drop	Triangle

Appendix C: Script of mindfulness induction (adapted from Kiburz, 2013)

For the next thirty minutes, I'm going to ask you to think about and try a particular kind of awareness called mindfulness. Mindfulness is paying attention in the present moment with openness and curiosity instead of judgement. Recent psychology studies have found that mindfulness can be helpful for people in many ways: lowered stress, better sleep, less anxiety, and lower levels of depression. We often focus on things other than what is happening in the moment: worrying about the future, thinking about the past, focusing on what is coming next rather than what is right in front of us. And, it is useful that we can do a number of things without really paying attention to them, however, sometimes it is helpful to bring our attention, particularly a curious and kind attention to what we are doing in the moment. Sometimes, we do pay close attention to what we are thinking and feeling and we become very critical of our thoughts and feelings. We try to change them or distract ourselves, because this critical awareness can be very painful. For example, we might notice that while we are working on one task at work, we are worrying about an uncompleted task or something we will have to do later, and think "I'm no good at my job!" "What's wrong with me?" "If I can't stop worrying about other things, I'll never be able to focus on finishing this task." Being mindful falls between these two extremes. We pay attention to what is happening inside and around us, we see events and experiences as what they are, and we allow things that we cannot control to be as they are, or we focus our attention on the task at hand. For example, when participating in the same task as before, you might notice those same worries about the unfinished task. Take a moment to react. "This is how it is now." "There go my thoughts again." And then gently bring our attention back to the task at hand. This second part of mindfulness, holding our judgments loosely, and not trying to change our thoughts and feelings, can be especially difficult. In fact, often being

mindful can involve not judging our tendency to have judgments. Mindfulness is a process, we do not reach a final and total state of mindfulness. Instead, mindfulness is losing our focus 100 times and returning to it 101 times. The best way to understand mindfulness is to practice it. So let's do that now.

The first exercise we will try today is sitting with the breath. To do this, assume a comfortable posture, keep the spine straight, and let your shoulders drop. Close your eyes, if it feels comfortable. Bring your attention to your belly. Feeling it expand on the inbreath, and recede on the outbreath. Keep the focus on your breathing, being with each inbreath for its full duration. Be with each outbreath for its full duration. As if you were riding the waves of your own breathing. Let's begin now.

[3 minutes for practice]

Every time you notice that your mind has wandered off of the breath, notice what it was that took you away. Then gently bring your attention back to your belly, and the feeling of your breath coming in and out.

[3 minutes for practice]

If your mind wanders away from the breath 1000 times, then your job is simply to bring it back to the breath, no matter what it becomes occupied with. Breathing in and breathing out.

[3 minutes for practice]

Be sure to keep your attention on your breath, feeling your stomach expand on the inbreath and recede on the outbreath. In and out. In and out.

[3 minutes for practice]

Be present in this moment with your breath. Each time your mind wanders off of your breathing. Redirect your attention to your breath. Focus on the inbreath and focus on the outbreath.

[3 minutes for practice]

I hope that you enjoyed this opportunity to practice sitting with your breath. This is a basic mindfulness based exercise. Practicing sitting with your breath is a great way to incorporate mindfulness into your everyday life, so that you are truly able to see its positive effects. What did you notice about the experience? Was it difficult to keep your attention on the breath? How did you react when your mind wandered?

[1 minute for reflection]

I hope that you enjoyed explore the ideas of mindfulness through these exercises. Now remember, mindfulness is not just these exercises, it is a principle of awareness that you can incorporate into your life. You can practice being in the moment while you are walking, showering, washing dishes, or during almost any other activity. You can also practice each of these exercises, lengthening the duration as you continue to practice mindfulness. Just try to attend to the present and dismiss ruminating thoughts and worries from your mind. How might these skills you learned today better help you balance the conflicting demands in your life? Help you focus on the task at hand, rather than the things that are worrying you? Might you become better aware of how you react to things in your environment? Might you better be able to handle the stress of your daily life? Might you better understand what you want from your daily activities and what you prefer and how to bring your attention back to the task you are working on?

Appendix D: Open-ended mindfulness questions

Please respond to the following questions with a few sentences. There are no right or wrong answers, so please be as honest and thoughtful as possible.

1. During the first exercise, “sitting with the breath,” what did you notice about the experience?
2. During the first exercise, “sitting with the breath,” was it difficult to keep your attention on the breath? How did you bring your attention back to the breath?
3. During the first exercise, “sitting with the breath,” how did you react when your mind wandered?
4. How might you apply the skills you learned from these mindfulness exercises during your daily life?
5. Are there any obstacles to applying the skills you learned? How might you overcome them?
6. Do you feel like you were you mindfully meditating?

Appendix E: Mindfulness knowledge measure

Please select the best answer to each of the following statements.

1. Mindfulness is paying attention in the present moment with
    a. openness and curiosity instead of judgement
    b. accuracy and knowledge instead of emotions
    c. clarity and peace instead of blind energy
    d. all senses instead of just one
2. Mindfulness is _____, we do not reach a final and total state of mindfulness
    a. Difficult
    b. A process
    c. Illusive
    d. An ideal
3. Mindfulness is a _____ that you can incorporate into your life
    a. Principle of awareness
    b. Type of meditation
    c. Set of exercises
    d. Hobby

Appendix F: Script of control induction (adapted from Kiburz, 2013 and Zeidan et al., 2010)

For the next thirty minutes, I'm going to ask you to think about and try relaxing. Relaxing allows you to simply be content. Recent psychology studies have found that relaxing can be helpful for people in many ways: lowered stress, better sleep, less anxiety, and lower levels of depression. We often find a need to slow down and relax. Life can be chaotic and we need to simply relax without any worries or concerns. Letting our minds wander can help us to achieve these goals. Sometimes, we do pay close attention to what we are thinking and feeling and we become very critical of our thoughts and feelings. We try to change them or distract ourselves, because this critical awareness can be very painful. For example, we might notice that while we are working on one task at work, we are worrying about an uncompleted task or something we will have to do later, and think "I'm no good at my job!" "What's wrong with me?" "If I can't stop worrying about other things, I'll never be able to focus on finishing this task." Letting our mind wander helps us to simply relax and forget these worries. For example, when participating in the same task as before, you might notice those same worries about the unfinished task. Take a moment to simply let your mind wander. Mind wandering is a process, we do not reach a final and perfect thought. Instead, mind wandering well is letting your brain find 100 thoughts and then finding the 101st thought. The best way to understand mind wandering is to practice it. So let's do that now.

Today we will be mind wandering while sitting with the breath. To do this, assume a comfortable posture, keep the spine straight, and let your shoulders drop. Close your eyes, if it feels comfortable. Be prepared to let your mind wander. Let's begin by allowing your mind to roam.

[3 minutes for practice]

There is no need to focus on anything in particular.

[3 minutes for practice]

Just let your mind wander.

[3 minutes for practice]

Openly let your thoughts flow.

[3 minutes for practice]

Let yourself think freely about whatever you want, just let your mind wander.

[3 minutes for practice]

I hope that you enjoyed this opportunity to practice letting your mind wander. This is a basic relaxation exercise. Practicing mind wandering is a great way to incorporate relaxation into your everyday life, so that you are truly able to see its positive effects. What did you notice about the experience? Was it difficult to find the next thought?

[1 minute for reflection]

I hope that you enjoyed exploring the ideas of relaxation through mind wandering. Now remember, relaxation is not just this, it is a principle that you can incorporate into your life. You can practice mind wandering daily. How might these skills you learned today better help you balance the conflicting demands in your life?

Appendix G: Checklist to aid in primary task completion.

- □ BLUE in the TOP row
- □ BROWN in the SECOND row
- □ GREEN in the THIRD row
- □ GREY in the FOURTH row
- □ RED in the FIFTH row
- □ YELLOW in the BOTTOM row
- □ ONEs in the FIRST AND LAST columns
- □ TWOs in the SECOND AND NINTH columns
- □ THREES in the THIRD AND EIGHTH columns
- □ FOURS in the FOURTH AND SEVENTH columns
- □ FIVES in the FIFTH AND SIXTH columns
- □ Same shapes are NOT touching in the rows
- □ Same shapes are NOT touching in the columns
- □ ALL 60 cards are visible
- □ Blue lightning bolt in the top left
- □ Blue flower in the top right
- □ Yellow star in the bottom left
- □ Yellow triangle in the bottom right
- □ Removed Blue 3 tear drops
- □ Removed Blue 5 triangles
- □ Removed Blue 5 tear drops
- □ Removed Blue 3 moons
- □ Removed Brown 3 moons
- □ Removed Brown 3 flowers
- □ Removed Yellow 5 tear drops
- □ Removed yellow 5 triangles
- □ There are only 52 cards
- □ Double-checked that all of the above have been completed

Appendix H: Secondary task

FIRST NAME: _____

LAST NAME: _____

U ID: _____

SONA ID: _____

WHAT COURSES (AND INSTRUCTORS) ARE YOU ENROLLED IN THAT TAKE SONA CREDIT *THIS* SEMESTER?

COURSE TITLE: _____INSTRUCTOR: _____
COURSE TITLE: _____INSTRUCTOR: _____
COURSE TITLE: _____INSTRUCTOR: _____
COURSE TITLE: _____INSTRUCTOR: _____

PLEASE DESCRIBE ANY OTHER STUDIES YOU HAVE COMPLETED FOR SONA CREDIT *THIS* SEMESTER:

_____
_____
_____
_____
_____

HOW MANY *OVERALL* SONA POINTS DO YOU NEED *THIS* SEMESTER? _____

HOW MANY *REMAINING* SONA POINTS DO YOU NEED *THIS* SEMESTER? _____

Appendix I: Demographic information

Please answer the questions about yourself and your parents/guardians to the best of your knowledge. If you do not know the answer to the question or the question does not apply to you, please write "N/A" to indicate it is not applicable.

1. What is your sex?
   - ☐ Male
   - ☐ Female

2. What is your age?
   _____

3. What is your race or ethnic background? (check all that apply):
   - ☐ White/Caucasian
   - ☐ Black/African American
   - ☐ Hispanic or Latino
   - ☐ Asian
   - ☐ Pacific Islander or Native Hawaiian
   - ☐ American Indian
   - ☐ Alaskan Native
   - ☐ Middle Eastern
   - ☐ Other: Please Describe_____

4. Are you fluent in more than one language?
   - ☐ Yes
   - ☐ No

5. Marital Status:
   - ☐ Single
   - ☐ Married
   - ☐ Separated
   - ☐ Divorced
   - ☐ Widowed
   - ☐ Living with Another
   - ☐ Domestic Partnership

6. Class:
   - ☐ Freshman
   - ☐ Sophomore
   - ☐ Junior

☐ Senior

7. How many credit hours are you enrolled in this semester?
   _____

8. Major: _____

9. Minor: _____

10. Do you have any other degrees?
    ☐ Yes
    ☐ No
    If Yes, please list them here: _____

11. What is your employment status?
    ☐ Not Employed, Full-time Student
    ☐ Not Employed, Part-time Student
    ☐ Employed Part-Time
    ☐ Employed Full-Time
    ☐ Self-Employed

12. GPA: _____

13. SAT Score: _____
    Verbal:_____
    Math: _____

14. ACT Score: _____

15. Are you the first one in your immediate family to attend college?
    ☐ Yes
    ☐ No
16. How often do you practice yoga?
    ☐ Never (not once)
    ☐ Rarely (a few times a year or less)
    ☐ Sometimes (about once a month)
    ☐ Frequently (about once a week)
    ☐ Always (about once a day)

17. How often do you practice meditation?
    ☐ Never (not once)
    ☐ Rarely (a few times a year or less)
    ☐ Sometimes (about once a month)
    ☐ Frequently (about once a week)
    ☐ Always (about once a day)

18. How often do you practice extended prayer?
- ☐ Never (not once)
- ☐ Rarely (a few times a year or less)
- ☐ Sometimes (about once a month)
- ☐ Frequently (about once a week)
- ☐ Always (about once a day)

Appendix J: Modified NASA-TLX (adapted from Hart & Staveland, 1988)

The following questions deal with the workload that you experienced while completing the task. Please circle the response on each of the following three scales that most closely matches your experience.

	Very Low	**Low**	**Somewhat Low**	**Neither Low nor High**	**Somewhat High**	**High**	**Very High**
1. How much mental activity was required for you to complete the task?	1	2	3	4	5	6	7
2. How much time pressure did you feel due to the rate or pace at which you had to complete the task?	1	2	3	4	5	6	7
3. How hard did you have to work (mentally) to complete the task?	1	2	3	4	5	6	7

Appendix K: State Mindfulness Scale (adapted from Tanay & Bernstein, 2013)

Please indicate to what extent you had each experience during the (past thirty-minutes/training session).

	Not at all	**Rarely**	**Somewhat**	**To a great extent**	**Very Well**
1. I was aware of different emotions that arose in me.	1	2	3	4	5
2. I tried to pay attention to pleasant and unpleasant sensations.	1	2	3	4	5
3. I found some of my experiences interesting.	1	2	3	4	5
4. I noticed many small details of my experience.	1	2	3	4	5
5. I felt aware of what was happening inside of me.	1	2	3	4	5
6. I noticed pleasant and unpleasant emotions.	1	2	3	4	5
7. I actively explored my experience in the moment.	1	2	3	4	5
8. I clearly physically felt what was going on in my body.	1	2	3	4	5
9. I changed my body posture and paid attention to the physical process of moving.	1	2	3	4	5

10. I felt that I was experiencing the present moment fully.	1	2	3	4	5
11. I noticed pleasant and unpleasant thoughts.	1	2	3	4	5
12. I noticed emotions come and go.	1	2	3	4	5
13. I noticed various sensations caused by my surroundings (e.g., heat, coolness, the wind on my face).	1	2	3	4	5
14. I noticed physical sensations come and go.	1	2	3	4	5
15. I had moments when I felt alert and aware.	1	2	3	4	5
16. I felt closely connected to the present moment.	1	2	3	4	5
17. I noticed thoughts come and go.	1	2	3	4	5
18. I felt in contact with my body.	1	2	3	4	5
19. I was aware of what was going on in my mind.	1	2	3	4	5
20. It was interesting to see the patterns of my thinking.	1	2	3	4	5
21. I noticed some pleasant and unpleasant physical sensations.	1	2	3	4	5

Appendix L: Utility reactions (adapted from Morgan & Casper, 2000)

Please rate how satisfied you are with each of the following

	Very dissatisfied	**Dissatisfied**	**Neither**	**Satisfied**	**Very Satisfied**
1. The relevance of the training content to the task.	1	2	3	4	5
2. Training's emphasis on most important information.	1	2	3	4	5
3. The extent to which the course prepared you to perform the task more effectively.	1	2	3	4	5
4. The extent to which the training prepared you to perform new tasks.	1	2	3	4	5
5. The quality of this training overall.	1	2	3	4	5
6. Communication of training objectives in clear, understandable terms.	1	2	3	4	5
7. Match of training objectives with your idea of what would be taught.	1	2	3	4	5

Appendix M: Psychological strain (adapted from Lovibond & Lovibond, 1995)

	Strongly Disagree	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)	1	2	3	4	5	6	7
2. I perspired noticeably (e.g., hands sweaty) in the absence of high temperatures or physical exertion.	1	2	3	4	5	6	7
3. I was aware of dryness of my mouth.	1	2	3	4	5	6	7
4. I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion).	1	2	3	4	5	6	7
5. I had difficulty in swallowing.	1	2	3	4	5	6	7
6. I had a feeling of shakiness (e.g., legs going to give way).	1	2	3	4	5	6	7
7. I experienced trembling (e.g., in the hands).	1	2	3	4	5	6	7
8. I was worried about situations in which I might panic and make a fool of myself.	1	2	3	4	5	6	7

9. I found myself in situations which made me so anxious I was most relieved when they ended.	1	2	3	4	5	6	7
10. I feared that I would be "thrown" by some trivial but unfamiliar task.	1	2	3	4	5	6	7
11. I felt I was close to panic.	1	2	3	4	5	6	7
12. I felt terrified.	1	2	3	4	5	6	7
13. I felt scared without any good reason.	1	2	3	4	5	6	7
14. I had a feeling of faintness.	1	2	3	4	5	6	7
15. I found it hard to wind down.	1	2	3	4	5	6	7
16. I found it hard to calm down after something upset me.	1	2	3	4	5	6	7
17. I found it difficult to relax.	1	2	3	4	5	6	7
18. I felt I was using a lot of nervous energy.	1	2	3	4	5	6	7
19. I was in a state of nervous tension.	1	2	3	4	5	6	7
20. I found myself getting upset rather easily.	1	2	3	4	5	6	7

21. I found myself getting upset by quite trivial things.	1	2	3	4	5	6	7
22. I found myself getting agitated.	1	2	3	4	5	6	7
23. I tended to over-react to situations.	1	2	3	4	5	6	7
24. I found that I was very irritable.	1	2	3	4	5	6	7
25. I felt that I was rather touchy.	1	2	3	4	5	6	7
26. I was intolerant of anything that kept me from getting on with what I was doing.	1	2	3	4	5	6	7
27. I found myself getting impatient when I was delayed in any way.	1	2	3	4	5	6	7
28. I found it difficult to tolerate interruptions to what I was doing.	1	2	3	4	5	6	7

Appendix N: Perceived intrusions scale (adapted from Fletcher, Potter, Telford, 2016)

How often did the following experience occur while you were completing the task?

	Never	**Very Rarely**	**Rarely**	**Occasionally**	**Frequently**	**Very Frequently**
1. Interruptions from other people prevented me from working on my task.	1	2	3	4	5	6
2. Other people prevented me from making progress on a task I was working on.	1	2	3	4	5	6
3. Unexpected demands from others stopped me from getting any further in the task I was working on.	1	2	3	4	5	6
4. I could not continue the work I started because of interruptions by others.	1	2	3	4	5	6

Appendix O: IRB Approval Letter

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX(813)974-7091

10/29/2015

Keaton Fletcher, B.A., B.S.
Psychology
4202 East Fowler Ave
Tampa, FL 33620

RE: **Expedited Approval for Initial Review**
IRB#: Pro00024070
Title: Workload and Intentional Cognition

Study Approval Period: 10/28/2015 to 10/28/2016

Dear Mr. Fletcher:

On 10/28/2015, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Protocol Version 1. 10.06.15.doc

Consent/Assent Document(s):
Workload Informed Consent Ver_1 10-25-2015.docx

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(4) Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.