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Why does mindfulness reduce aggression? : exploring the role of response inhibition

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ABSTRACT

WHY DOES MINDFULNESS REDUCE AGGRESSION?
EXPLORING THE ROLE OF RESPONSE INHIBITION

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Mindfulness-based interventions are increasingly being used to reduce aggressive behavior; however, the mechanisms through which increases in mindfulness are associated with reductions in aggression are not well understood. Based on research suggesting that mindfulness-induced alterations to inhibitory control might be a potential mechanism for this effect, the present study evaluated whether a single, brief mindfulness induction would have immediate, state-based effects on aggressive behavior and whether, if present, such effects would be partially explained by mindfulness-induced changes to inhibitory control. A focused breathing exercise was used to induce mindfulness in a sample of aggressive, mindfulness-naïve, male undergraduates whose performances on the Stroop task and Taylor Aggression Paradigm were then compared to that of a control group (N = 65). No significant between-groups differences in TAP performance or Stroop interference scores were detected, and response inhibition was not a significant predictor of aggressive behavior. Results suggest that the previously identified effects of mindfulness on inhibitory control and

aggressive behavior may not be present after a single mindfulness induction. Problems with operationalizing and assessing mindfulness are discussed.

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DEDICATION

To Kyle and William

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CHAPTER 1

INTRODUCTION

Mindfulness, commonly defined as the practice of cultivating non-judgmental, present-focused attention (Kabat-Zinn, 1994), is a rapidly growing area of research in the psychological sciences that has seen widespread application to various psychological constructs and interventions (e.g., Brown & Ryan, 2003; Kabat-Zinn, 1990). Applied to the study of aggression, research has demonstrated that individuals high in trait mindfulness are less likely to behave aggressively. Further, studies have linked mindfulness training with reductions in aggressive behavior (Heppner et al., 2008; Samuelson, Carmody, Kabat-Zinn, & Bratt, 2007). As a result, mindfulness-based interventions have become increasingly common components of treatments for aggressive behavior (Fix & Fix, 2013). In order to utilize mindfulness-based treatments most effectively, it is important to more fully understand how mindfulness impacts one's propensity for aggression. However, little is currently known about the mechanisms through which this relationship operates.

Among the many proposed mechanisms of the relationship between mindfulness and aggression are elements of executive functioning, including response inhibition, which may be particularly influential in this relationship. Theoretically, aggressive behavior has often been characterized by problems with response inhibition (Berkowitz, 2008), and research has demonstrated that individuals who exhibit deficits in response inhibition are more likely to engage in aggressive behavior (Cohen et al., 2003). In contrast, a positive relationship has

been found between mindfulness and response inhibition, such that greater mindfulness is associated with better inhibitory control (Chan & Woollacott, 2007; Moore & Malinowski, 2009). Moreover, mindfulness-based treatments have been shown to increase participants' capacity for response inhibition (Friese, Messner, & Schaffner, 2012; Wenk-Sormaz, 2005). Taken together, these findings suggest that response inhibition may account, in part, for the association between mindfulness and reductions in aggressive behavior.

While research has linked deficits in response inhibition to aggression, studies that have identified this relationship have been correlational, not causal, in nature. For example, existing studies have demonstrated that violent individuals perform more poorly on assessments of response inhibition compared to non-violent controls (e.g., Cohen et al., 2003). However, available studies have not directly assessed response inhibition prior to or during provocation and aggressive responding. Accordingly, it cannot be determined whether decreased response inhibition in the context of provocation contributes directly to the likelihood for aggressive responding. Thus, studies that evaluate the impact of variations in response inhibition on aggressive behavior are needed in order to establish the relationship between response inhibition and aggression as causal in nature.

Studies of this kind have been conducted to verify the nature of the relationship between mindfulness and response inhibition and have provided causal evidence that improvements in mindfulness increase inhibitory control (Heeren, Van Broeck, & Philippot, 2009; Tang et al., 2007). However, available research has not yet determined the amount of mindfulness training necessary to generate such improvement. As most of the available research on the association between mindfulness and response inhibition has been conducted

in the context of mindfulness-based interventions, post-test assessments of inhibitory control have typically occurred after participants have had repeated opportunities to learn and practice mindfulness techniques (e.g., Heeren et al., 2009; Tang et al., 2007; Wenk-Sormaz, 2005). As a result, these studies suggest that training in mindfulness might alter response inhibition through repeated practice. However, given that available research does not assess inhibitory control immediately following participants' first exposure to mindfulness, it cannot be determined whether mindfulness has more immediate, state-based effects on response inhibition. Such assessments are necessary in order to determine whether improved inhibitory control is more characteristic of being in a mindful state, regardless of the amount of mindfulness training that has occurred. If this were the case, then changes in inhibitory control would be expected to be present following a single successful induction of mindfulness, as opposed to only arising after extensive training in mindfulness techniques.

Given the associations between both response inhibition and mindfulness and response inhibition and aggressive behavior, the present study aimed to determine whether improvements to inhibitory control might partially explain why mindfulness-based treatments have been successful at reducing aggressive behavior. Additionally, the present study evaluated the extent to which a single mindfulness induction influenced the effect of mindfulness on response inhibition. Finally, this study used an experimental design to manipulate response inhibition prior to assessments of aggressive behavior in order to determine whether participants' capacity for inhibitory control is causally associated with their propensity for aggression.

Mindfulness

Mindfulness Defined

The concept of mindfulness is derived from the Buddhist contemplative tradition of mindful meditation, known as *sattipatana vipassana* (Kabat-Zinn, 1982). In the Buddhist tradition, mindful meditation is characterized by sustained attention to the ongoing flow of experiences, including any thoughts, emotions, or sensations that arise, without exercising judgment or interpretation toward them (Kabat-Zinn, 1982). Mindfulness has variably been defined as "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 1994, p. 4); "bringing one's complete attention to the present experience on a moment-to-moment basis" (Marlatt & Kristeller, 1999, p. 68); "an enhanced attention to and awareness of current experience or present reality" (Brown & Ryan, 2003, p. 822); and "the nonjudgmental observation of the ongoing stream of internal and external stimuli as they arise" (Baer, 2003, p. 125). Consistently across definitions, attention and awareness are seen as key components of mindfulness. Awareness is the constant monitoring of one's internal and external experience, whereas attention is a more focused awareness on a specific aspect of experience (Brown & Ryan, 2003). As described by Brown and Ryan (2003), attention and awareness work in tandem such that attention continuously identifies "figures" from the "ground" of awareness, which attention then holds in focus for varying lengths of time. When one is mindful, focused attention is momentarily placed on each experience in awareness as it arises and then is released in order to attend to the next element of experience. For example, one might be generally aware of the sensations of breathing while

attending specifically to the separate elements of experience it includes, such as the rise and fall of the chest, the sound of air moving through the nose, and the change in temperature of the air from inhalation to exhalation. At the same time, one would also be aware (and briefly attentive to) other experiences, including thoughts, emotions, other physical sensations, and stimuli from the environment. By dynamically directing attention in this way, rumination, absorption in the past or present, and judgment of the present experience are limited (Brown & Ryan, 2003). When these behaviors arise, they are simply noted as a component of the current experience, rather than engaged with cognitively.

Bishop and colleagues (2004) convened in an effort to propose an operational definition of mindfulness that is distinct from its spiritual roots and that can be used to facilitate more precision in research of its etiologies and outcomes. They identified a two-component model of mindfulness which includes 1) the self-regulation of attention toward the experience of the present moment and 2) a purposeful attitude of curiosity, openness, and acceptance toward present-moment experiences. Defined this way, mindfulness includes both a behavioral (focused attention) and attitudinal (non-judgment) component.

Mindfulness has alternately been conceptualized as both 1) a state of being or mode of awareness (i.e., nonjudgmental attention and awareness in the present moment; Bishop et al., 2004) and 2) a trait or general disposition (i.e., "the greater tendency to abide in mindful states over time"; Brown, Ryan, & Creswell, 2007, p. 218). However, in outlining their conceptualization of mindfulness, Bishop and colleagues (2004) argue that there may be trait-like differences in the frequency with which mindfulness is invoked, both dispositionally and as a result of training, but that mindfulness itself remains an active process to be engaged in (a

state), rather than a fixed characteristic of one's personality (a trait). They contend that mindfulness is a psychological process or way of acting, which must be actively engaged through focused self-regulation of attention and cultivation of openness and acceptance of experience. Thus, when one's experiences are actively approached in this manner, one is mindful, whereas when this approach is not taken, mindfulness ceases.

Mindfulness is typically cultivated from an occasionally experienced state to a more widespread approach to experience through the practice of mindful meditation (Samuelson et al., 2007). Mindful meditation typically consists of first focusing attention on one component of experience (e.g., monitoring one's breathing) until attention is reasonably sustained and then gradually expanding the field of awareness until ultimately all internal and external components of experience are attended to as they occur (Kabat-Zinn, 1982). However, mindfulness training is not limited to traditional sitting meditation techniques. The extant literature includes numerous examples of mindfulness exercises, both highly structured (e.g., mindful raisin eating; Kabat-Zinn, 1990) and unstructured (e.g., following your breath; Kabat-Zinn, 1990). Exercises may cultivate focused, concentrative attention on internal experiences (e.g., thoughts, emotions, breath) or external experiences (e.g., sights, sounds, or smells in the environment), or they may foster a more receptive, open awareness of the broader field of experiences as they arise in the present moment (e.g., observing and noting experiences as they occur). Across exercises, however, the goal remains the same: to observe experiences of the present moment without judgment (Baer, 2003).

Mindfulness Associations and Applications

Mindfulness has been repeatedly identified as a predictor of overall psychological well-being, as well as a protective factor against psychopathology and other adverse outcomes (Brown & Ryan, 2003). For instance, higher levels of mindful attention and awareness have been associated with a number of measures of well-being, including increased positive affect, life satisfaction and self-esteem, and decreased depression, angry hostility, and impulsivity (Brown & Ryan, 2003). As a result, it has seen widespread application in the field of psychology, particularly as an intervention tool in a variety of well-supported treatments, including Mindfulness-Based Stress Reduction (MSBR; Kabat-Zinn, 1990), Dialectical Behavioral Therapy (Linehan, 1993), and Acceptance and Commitment Therapy (Hayes, Strosahl, & Wilson, 1999). Mindfulness has been used for the treatment of chronic pain (Chiesa & Serretti, 2011), anxiety (Kabat-Zinn et al., 1992), depression (Segal, Williams, & Teasdale, 2002), substance abuse (Marlatt & Gordon, 1985), trauma (Follette, Palm, & Pearson, 2006), and binge eating (Kristeller & Hallett, 1999), to name a few. Constructs such as anger, aggression, and hostility have also been empirically evaluated both for associations with mindfulness and as targets for mindfulness-based interventions, and each of these has been found to decrease following mindfulness-based interventions (e.g., Fix & Fix, 2013; Samuelson et al., 2007).

Mindfulness and Aggression

Mindfulness-based treatments focus on non-judgmental acceptance and calm, deliberate behavior, making them obvious targets for exploration in the treatment of

aggressive behavior. Mindfulness is associated with greater self-regulation of emotion and behavior (Brown & Ryan, 2003) and therefore might be useful for the regulation of anger and aggressive behavior more specifically. Further, being mindful may allow us to experience threatening information about ourselves in a less defensive, more accepting away, thus lessening the impetus for an aggressive response (Gallagher, Hudepohl, & Parrott, 2010). Mindfulness calls for the acceptance of emotional experiences without immediately attempting to avoid or act on them. Accordingly, Wright, Day, and Howells (2009) argue that mindfulness training may facilitate increased tolerance of anger and provide opportunities for exposure to anger without action, which may ultimately extinguish otherwise dominant aggressive reactions. Finally, mindfulness is thought to further reduce reflexive responding by teaching individuals to become less fused with emotional experiences, allowing for responses to experiences that are more flexible and less automatic, which may ultimately result in reductions in aggressive behavior (Wupperman et al., 2012). While the mechanisms through which mindfulness decreases aggression are yet unclear, trait mindfulness (i.e., one's tendency to experience mindful states) has repeatedly shown an inverse relationship with aggressive behavior (e.g., Heppner et al., 2008; Kelley & Lambert, 2012), and the profusion of treatments that have successfully applied mindfulness-based techniques to the reduction of anger and aggressive behavior suggest that it is a promising treatment approach that warrants further exploration and dismantling of its effects (e.g., Fix & Fix, 2013; Samuelson et al., 2007).

Dispositional Mindfulness and Associations with Aggression

Associations between increased dispositional (trait) mindfulness and decreased aggression have been repeatedly demonstrated across a variety of samples (e.g., Borders, Earleywine, & Jajodia, 2010; Heppner et al., 2008; Kelley & Lambert, 2012). In a student sample, Heppner and colleagues (2008) found that higher self-reported mindfulness was associated with decreased verbal aggression, hostility, anger, and total aggressiveness as reported on the Aggression Questionnaire (AQ; Buss & Perry, 1992); however, mindfulness was unrelated to the physical aggression subscale of the AQ. In contrast, Borders and colleagues (2010) found that higher rates of physical and verbal aggression reported on the AQ were associated with decreased dispositional mindfulness. These results were consistent across two samples, including college students and members of a mindfulness-based web community (Borders et al., 2010). Kelley and Lambert (2012) found similar results in a sample of undergraduate criminal justice students, demonstrating that higher self-reported trait mindfulness was associated both with decreased physical and verbal aggression as well as decreased hostility and anger, as reported on the AQ.

Associations with mindfulness have also been found in the context of intimate partner violence (IPV; e.g., Shorey, Seavey, Quinn, & Cornelius, 2013; Stith & Hamby, 2002; Thompson, Crouch, & Milner, 2014). In a sample of community adults, Thompson and colleagues (2014) found that self-reported physical and verbal IPV, as reported on the Revised Conflict Tactics Scale (CTS2; Straus, Hamby, Boney-McCoy,& Sugarman, 1996), was inversely associated with dispositional mindfulness. Similarly, Stith and Hamby (2002) found that increased awareness of physiological signs of anger was associated with decreased

physical, psychological, and sexual aggression toward one's intimate partner. While they did not assess mindfulness directly, awareness of one's physiological reactions represents attention and awareness in the present moment, which is one of the foundations of mindfulness practice.

Shorey et al. (2013) evaluated associations between mindfulness and dating violence perpetration in a sample of female undergraduates. Their investigation utilized a multi-dimensional self-report assessment of mindfulness: the Five-Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). Their results indicated that higher scores on the mindful non-reactivity and act-with-awareness dimensions were associated with decreased physical and psychological dating violence. This suggests that individuals who are able to inhibit initial responses to stimuli and ultimately make conscious choices, informed by awareness, are less likely to engage in violence toward a dating partner.

Finally, in a community sample of men, Gallagher et al. (2010) evaluated associations between trait mindful awareness and sexual aggression in the context of alcohol consumption. They found that trait mindfulness moderated the relationship between greater alcohol consumption and sexual aggression toward intimate partners such that heavy drinking was associated with an increase in sexual aggression for individuals low (but not high) in trait mindfulness. The authors suggested that drinking can decrease the ability to detect cues that one's partner does not want to engage in sexual activity and that greater mindfulness might buffer against this decrease in awareness. It might also be hypothesized that the reason intoxication is not associated with an increase in sexual aggression among more mindful men

is that more mindful men also have an increased capacity for inhibitory control, compared with men who are less mindful.

Reductions in Aggression Following Mindfulness-Based Treatments

Numerous studies have also found reductions in aggression following mindfulness-based treatments for individuals previously low in dispositional mindfulness or otherwise unexposed to mindfulness-based practices (e.g., Fix & Fix, 2013; Samuelson et al., 2007). For instance, in a report of outcomes of MBSR with a sample of inmates, Samuelson and colleagues (2007) demonstrated that inmates experienced a decrease in total hostility (including hostile attributions, hostile affect, hostile aggression, aggressive responding [i.e., aggressive behavior], cynicism, and social avoidance) following participation in MBSR. Additionally, Chapman, Hare, Caton, Donalds, McInnis, and Mitchell (2013) reviewed a series of studies that used mindfulness-based techniques for reducing aggressive behavior among individuals with intellectual disabilities. The majority of the studies they reviewed utilized Soles of the Feet (Singh, Wahler, Adkins, & Myers, 2003), a mindfulness-based meditation program in which individuals are taught to divert their attention away from emotionally charged stimuli and toward the neutral stimulus of the soles of their feet. Other interventions in their review included focusing on breathing, thoughts, and neutral stimuli in the environment (e.g., sounds, clouds). In each of the studies they reviewed, participants' frequency of physically aggressive episodes decreased following completion of the mindfulness-based meditation program.

Fix and Fix (2013) conducted a systematic review of empirical evaluations of the use of mindfulness to reduce aggressive behaviors, which included Samuelson et al. (2007) and the studies reviewed by Chapman et al. (2013), as well as interventions with non-intellectually disabled populations (i.e., undergraduates, inmates, and psychiatric inpatients). Fix and Fix (2013) identified eleven studies for the review, which they separated based on design: four group-treatment studies and four individual-treatment studies. Three of the four group-treatment studies found significant reductions in participant physical aggression, including significant group differences in two of the three studies that included control groups. Six of the seven individual treatment studies utilized the Soles of the Feet meditation described above and found significant reductions in aggressive behavior among young adolescents, individuals in an inpatient psychiatric hospital, and individuals with a diagnosis of mental retardation or an autism spectrum disorder. Results for the remaining study, which used a modified MBSR program to reduce driving anger, found that participants self-reported a decrease in driving anger; however, decreases in physiological markers of anger (e.g., blood pressure, pulse) in response to anger-provoking driving-related stimuli were not found. Taken together, the research reviewed by Fix and Fix (2013) provides support for the use of mindfulness-based treatments as interventions for aggressive behavior.

Wupperman and colleagues (2012) introduced Mindfulness and Modification Therapy (MMT) for behavioral dysregulation, a transdiagnostic approach to treating a range of dysregulated behaviors, including substance abuse and aggression. In their pilot study, Wupperman et al. (2012) included 14 women who had been court-referred for domestic violence and alcohol problems. All participants had engaged in at least one act of physical

violence toward another adult (i.e., their partner or another close friend or family member) and met criteria for alcohol abuse or dependence. Some of the participants also reported additional drug use (i.e., cocaine and cannabis). Treatment included 60- to 90-minute weekly sessions over a period of 12 weeks. The primary goal of MMT was identified as helping clients "experience and tolerate the present moment" (Wupperman et al., 2012, p. 4), including times when the present moment includes aversive thoughts and emotions, without engaging in maladaptive coping behaviors. Essentially, Wupperman and colleagues (2012) sought to increase participants' use of mindfulness as a means for coping with distress instead of responding to their distress in maladaptive ways (e.g., substance abuse and aggression). In addition to training in mindfulness, treatment included supplemental work in the areas of self-compassion, communication, and assertiveness. Wupperman et al. (2012) used the Timeline Follow-Back Assessment Method (Sobell & Sobell, 1996) to track substance use and physical aggression. Results revealed significant decreases with large effect sizes in both substance use (i.e., number of days used, amount used) and physical aggression (i.e., number of aggressive acts) when comparing self-reports during the four weeks prior to treatment to those during the last four weeks of treatment. Wupperman and colleagues' (2012) findings are limited by their lack of a control group and post-treatment follow-up; however, they provide preliminary support for the use of mindfulness-based treatments for reducing aggressive behavior among female offenders of domestic violence.

Most of the research on mindfulness interventions for aggression assumes an increase in trait mindfulness following treatment; however, in the only study of its kind, Heppner and colleagues (2008) used a mindfulness intervention to evaluate the direct impact of state

mindfulness on aggressive responding. The authors informed college-student participants that they would participate in a task either independently or in a group depending on whether other participants chose to work with them. Participants were instructed to write about themselves and then were given the self-descriptions of other "participants" to rate. While the ratings were ostensibly being tallied, participants either participated in a mindfulness induction (e.g., raisin eating task; Kabat-Zinn, 1990) or sat alone in a quiet room. As a means of providing provocation for some of the participants, they then received feedback regarding whether they had been rated highly by the other participants and assigned to the group condition (accepted), or they had not been rated highly and would have to work alone (rejected). Participants were randomly assigned to one of three conditions: 1) accepted, 2) rejected, or 3) rejected + mindfulness. Finally, participants completed the Taylor Aggression Paradigm (TAP; Taylor, 1967), a competitive reaction-time task in which participants send and receive noise blasts for losing a trial. Results indicated that participants in the rejected condition selected significantly more severe noise blasts to send to their opponents than those in the accepted and mindfully rejected conditions. Further, the mindfully rejected participants did not differ from the accepted participants in the severity of the noise blasts they selected. These results suggest that being mindful may buffer against aggressive responding when provoked. These findings are also consistent with those of previous studies that demonstrate associations between increased mindfulness and decreased aggressiveness; however, they are the first to demonstrate such findings using a mindfulness induction and an empirical design. While replication of these results is key to establishing their validity, they provide support for the direct effect of state mindfulness on aggressive responding.

Mechanisms of Mindfulness

Individuals high in trait mindfulness engage in less aggressive behavior than those low in trait mindfulness (e.g., Borders et al., 2010; Heppner et al., 2008; Kelley & Lambert, 2012), and mindfulness-based treatments have shown promise for reducing aggressive behavior (Fix & Fix, 2013; Heppner et al., 2008; Samuelson et al., 2007; Wupperman et al., 2012); however, research assessing the processes through which mindfulness and aggression are connected remain limited. Many potential mechanisms through which mindfulness might reduce aggressive behavior have been proposed, including (but not limited to) better emotion regulation, decreased rumination, relaxation (Borders et al., 2010; Wright & Howells, 2009), de-identification from thoughts, reduced emotional reactivity, enhanced self-monitoring (Wright & Howells, 2009), improved anger management (Shorey et al., 2013), and lower ego involvement (Heppner et al., 2008). However, few of these proposed mechanisms have been evaluated empirically (Borders et al., 2010).

One promising potential mechanism of the association between mindfulness and aggression is improved executive functioning, particularly in the area of response inhibition (Borders et al., 2010; Friese, Messner, & Schaffer, 2012). Theoretically and empirically, mindfulness has been associated with improved inhibitory control and cognitive flexibility (e.g., Jha, Krompinger, & Baime, 2007; Moore & Malinowski, 2009), whereas aggression has been found to relate to disinhibition, impulsivity, and deficits in planning and goal-directed behavior (e.g., Cohen, 2013).

The Executive Function of Response Inhibition: A Potential Mechanism

Executive Functioning Defined

Executive functioning is typically associated with the functions of the prefrontal cortex, where executive functioning processes are believed to occur (Stuss & Alexander, 2000; Suchy, 2009). However, definitions of executive functioning and the processes thought to be subsumed by executive functioning are varied throughout the literature. Executive functioning has been defined as the ability "to activate...behavioral responses...to maintain serial order...to monitor and manage basic psychological functions...and to ruminate about past behaviors and to contemplate future activities" (Benson, 1993, p. 78), to "organize a behavioral response to solve a complex problem...activation of remote memories, self-direction and independence from environmental contingencies, shifting and maintaining behavioral sets appropriately, generating motor programs, and using verbal skills to guide behavior" (Mega & Cummings, 1994, p. 361), and "a multifaceted neuropsychological construct consisting of a set of higher-order neuro-cognitive processes that allow higher organisms to make choices and to engage in purposeful, goal-directed, and future-oriented behavior" (Suchy, 2009, p. 106). Perhaps most commonly, however, executive functioning has been defined based on the classic writings of Luria (1966, 1973), who viewed executive functioning as a collection of higher-order cognitive processes involved in the planning, initiation, and self-regulation of goal-directed behavior.

Over time, many processes have been put forth as being subsumed under the umbrella of executive functioning, including, but not limited to, attention, set shifting (i.e., cognitive

flexibility), planning, organization, hypothesis generation, self- and social monitoring, response inhibition, abstract reasoning, and working memory (Giancola, 2000; Hoaken, Giancola, & Pihl, 1998; Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000; Stuss & Alexander, 2000). However, there is widespread disagreement regarding what executive functioning includes, how it is organized (e.g., as a unitary or multi-factored construct), and which neurological structures are responsible for its actions. Such disagreements have contributed to the lack of an operational definition or unified understanding of the roles of executive functioning.

To address these challenges, Miyake and colleagues (2000) used factor analysis to explore the organization of executive functioning. Their results support the existence of three distinct but interrelated processes: set shifting/cognitive flexibility, monitoring and updating working memory, and response inhibition (Miyake et al., 2000). Set shifting or cognitive flexibility refers to the ability to flexibly shift one's attention between various components of experience. Updating/monitoring working memory involves monitoring and coding incoming information and integrating it with previous information relevant to a given task. Finally, response inhibition is the ability to intentionally inhibit a prepotent, automatic, and overlearned response in favor of a less dominant response (Miyake et al., 2000).

Executive Functioning and Mindfulness

The roles of executive functioning in mindfulness practice are inherent in definitions of mindfulness as a construct. In their two-component model of mindfulness (i.e., sustained attention to the present moment with an emphasis on acceptance of the present-moment

experience), Bishop and colleagues (2004) break down the component of present-moment attention further to include three facets of attention regulation: 1) sustained attention, 2) attention shifting (i.e., set-shifting), and 3) inhibition of secondary elaborative processing of experiences as they arise (i.e., response inhibition). Similarly, Shapiro, Carlson, Astin, and Freedman (2006) proposed that attention in the context of mindfulness requires three types of attention regulation: 1) sustained concentration, 2) inhibition of secondary processing of thoughts and feelings (i.e., response inhibition), and 3) flexible switching between experiences as they arise (i.e., set shifting). In both theories, the executive functions of response inhibition and set shifting are emphasized. Sustained attention is included in some, but not all, conceptualizations of executive functioning; however, it can be argued that sustained attention, which in the context of mindfulness allows for moment-to-moment awareness, is necessary for facilitating the awareness required to engage in set shifting and response inhibition. Accordingly, it is crucial to consider the impact mindfulness has on elements of executive functioning when trying to delineate the mechanisms of its effects.

Response Inhibition

In particular, the executive function of response inhibition may be of special relevance to the present review and proposed research, as it has important theoretical and empirical associations with aggressive behavior (Berkowitz, 2008). Response inhibition, or inhibitory control as it is more broadly described, is an effortful process that requires the deliberate, conscious inhibition of responses that may otherwise occur automatically. Reading, for example, becomes highly automatized through overlearning; we often read words we see

without intending to do so. When completing the Stroop task (Stroop, 1935), perhaps the most commonly used assessment of inhibitory control, participants must intentionally inhibit the dominant and automatic response of reading in favor of labeling the color of ink in which the color words are written in (e.g., identify that the word "red" is printed in blue ink, rather than reading the word). As another example, one engages in response inhibition when the automatic, prepotent tendency to scratch a rash or mosquito bite is resisted. Inhibiting scratching is effortful in that one must consciously choose to interrupt the scratching response, which will bring immediate relief, in favor of making a more goal-oriented choice of not scratching in the interest of ultimately faster healing.

Response Inhibition and Mindfulness

Bishop and colleagues (2004) argue that mindfulness enhances the self-regulation of attention, which in turn improves self-regulation of behavior more broadly. This may occur because the type of attention called for in mindfulness practice requires the ongoing exercise of response inhibition. When mindful, one repeatedly and deliberately inhibits the automatic tendency to respond to thoughts by engaging with them cognitively, in favor of simply noting them and remaining open to the ongoing flow of experience. In this way, response inhibition is engaged in continually during mindfulness and serves as a key component of mindfulness practice.

Shapiro and colleagues (2006) further argue that improvements in response inhibition, cultivated through mindfulness, interfere with the automaticity of our behavior. Mindfulness training teaches that individuals can identify impulses (e.g., to scratch an itch), choose to

inhibit automatic responses to them, and, instead, non-judgmentally allow them to be a part of their experience. In doing so, one recognizes that an impulse is a temporary part of the present- moment experience that will eventually pass, regardless of whether action is taken. When awareness of impulses and subsequent non-judgmental acceptance of them is attained, behavioral responses to impulses are resisted or selected thoughtfully, thus interrupting automatic behavior and improving the capacity for response inhibition (Ortner & Zelazo, 2012).

In the same way, Ortner and Zelazo (2012) purport that mindfulness may decrease automatic responding to emotionally evocative stimuli while increasing conscious choice in behavior selection. For example, a heightened perception of circumstances, thoughts, and physical sensations facilitated by mindful awareness may serve to alert one to the experience of anger and facilitate the deliberate selection of a response as opposed to responding automatically (e.g., in a potentially aggressive manner), thus reducing the likelihood of impulsive aggression. Empirically, increased mindfulness has repeatedly been associated with better inhibition on the Stroop task and on similar tasks of inhibition (e.g., Jha et al., 2007; Moore & Malinowski, 2009), supporting the theoretical argument that mindful moment-to-moment awareness may have a critical effect on the ability to interrupt automatic behavior patterns and inhibit otherwise dominant responses.

Response Inhibition and Impulsive Aggression

Theoretically, aggressive behavior has been associated with problems with impulsivity and poor response inhibition (Berkowitz, 2008). This is particularly true for impulsive

aggression, which is a specific subtype of aggression characterized by deficits in inhibiting automatic aggressive tendencies in response to provocation. Impulsive aggression is defined as a reflexive response to a stimulus that results in agitation and an aggressive response; it is distinguishable from premeditated aggression, which is planned, intentionally enacted, and goal oriented (Barratt, Stanford, Kent, & Felthous, 1997). Theoretically, difficulties with response inhibition would primarily be expected to contribute to impulsive aggression because impulsive aggression results from the failure to inhibit an automatic response to provocation, whereas premeditated aggression is planned and therefore unrelated to the ability to inhibit a prepotent response. Berkowitz (2008) goes so far as to argue that most aggressive behaviors actually occur automatically, thus necessitating a strong capacity for response inhibition to interrupt such reflexive reactions. Empirically, impulsive aggression, as compared to premeditated aggression, has been associated with higher trait impulsivity (Villemarette-Pittman, Stanford, & Greve, 2002), poorer behavioral control (White, Jarrett, & Ollendick, 2013), and greater problems with response inhibition (Atkins, Stoff, Osborne, & Brown, 1993; Ellis, Weiss, & Lochman, 2009; Stanford, Greve, & Gerstle, 1997).

Taken together, the associations between mindfulness and response inhibition, as well as the theoretical support for the role of response inhibition in aggressive behavior, suggest that response inhibition may be an important mechanism for exploration in understanding why mindfulness appears to reduce aggressive behavior. It may be that, over time, the use of response inhibition in the practice of mindfulness improves individuals' overall capacity to exercise response inhibition and subsequently decreases behavioral automaticity. Additionally, mindfulness may facilitate reductions in impulsive responding in a more state-

based fashion, such that the capacity for response inhibition is further enhanced during periods of mindfulness because it is intentionally cultivated during mindfulness practice. These general and state-based improvements to mindfulness would be expected to reduce aggressive behavior by facilitating individuals' ability to inhibit automatic, aggressive responses to provocation in favor of making a more intentional, premeditated response.

Empirical Associations Between Mindfulness and Response Inhibition

Trait Mindfulness and Meditation Experience

Across studies that have evaluated the response inhibition capabilities of meditators (i.e., those who have a history of practicing mindfulness meditation) and those with high trait mindfulness, the predominant finding has been that individuals who have more experience with non-judgmental present-moment awareness are better able to inhibit automatic responding (Chan & Woollacott, 2007; Jha et al., 2007; Moore & Malinowski, 2009; Teper & Inzlicht, 2013; van den Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010). These findings are clearly evident in outcomes on the Stroop task (e.g., Chan & Woollacott, 2007; Moore & Malinowski, 2009; Teper & Inzlicht, 2013). For instance, Chan and Woollacott (2007) presented meditators and non-meditators with a page of Xs presented in different ink colors (color condition; e.g., Xs variably printed in blue, green, and red), followed by a page of color words printed in incongruent ink colors (incongruent condition; e.g., the word "blue'" printed in green ink). For each page, participants were instructed to name the colors of as many items as they could in 45 seconds. They assessed difficulties with response inhibition using a Stroop interference score, which was calculated by subtracting the number of color

items participants labeled from the number of incongruent items they labeled. Their results revealed that total minutes of daily meditation was negatively correlated with Stroop interference and positively correlated with the number of items processed during the incongruent trial (Chan & Woollacott, 2007), suggesting that participants who meditated more frequently were better able to inhibit the dominant reading response in favor of labeling colors in the Stroop task, thus demonstrating superior response inhibition compared to non-meditators.

In another study of meditators and non-meditators, Teper and Inzlicht (2013) showed that errors committed in the incongruent Stroop condition were negatively correlated with years of meditation experience and were more common among non-meditators than meditators; however, these effects were only trending toward significance. In the same study, however, trait mindfulness as measured by the Philadelphia Mindfulness Scale (PHMS; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008) was significantly negatively correlated with Stroop errors. Like those of Chan and Woollacott (2007), these results demonstrate that more mindful individuals exhibit greater inhibitory control, allowing them to be better able to inhibit automatic responding.

Moore and Malinowski (2009) measured the response inhibition of meditators and non-meditators using the Stroop task and the D2 test of attention (Brickenkamp & Zilmer, 1998). The D2 test is a timed paper-and-pencil task that requires participants to retain specific rules regarding which targets to cross out in a field of visually similar distractor targets. Response inhibition on the D2 test is indexed by errors per items scanned, and scores on the D2 test have been shown to correlate significantly with performance on the Stroop task

(Brickenkamp & Zilmer, 1998). Results demonstrated that meditators and those with higher trait mindfulness, as measured by the Kentucky Inventory of Mindfulness Skills (Baer, Smith, & Allen, 2004), exhibited better performance on both the Stroop and D2 tests, further supporting the association between mindfulness and enhanced inhibitory control.

In addition to positive results with the Stroop task, other assessments of inhibitory control have also revealed response inhibition strengths among meditators and more mindful individuals (Jha et al., 2007; van den Hurk et al., 2010). Jha and colleagues (2007) compared the response inhibition of experienced meditators to non-experienced meditators using the Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002). The ANT, a computer-administered assessment, includes a conflict monitoring task in which participants are required to select a correct response (i.e., whether a target arrow points to the right or left) in the presence of stimuli that are either congruent (arrows pointing the same direction as the target) or incongruent (arrows pointing the opposite direction) with the target stimuli. For this component of the ANT, meditators exhibited superior response inhibition compared to non-meditators in that they performed significantly better when required to inhibit responding to the dominant cues (the incongruent arrows) in favor of selecting a less obvious response (the direction of the target arrow). In a subsequent study, van den Hurk et al. (2010) replicated Jha and colleagues' (2007) finding that experienced meditators demonstrate better inhibition of automatic responses on the conflict monitoring task of the ANT. Van den Hurk and colleagues (2010) argued that mindful individuals may be better able to inhibit automatic responding because they are more able to inhibit the shift of attention toward extraneous external and internal stimuli, which may trigger automatic responses. That is, they suggest

that it is the improved attentional control fostered by mindful meditation that may allow mindful individuals to inhibit automatic responding.

It should be noted that not all research has shown significant associations between mindfulness and response inhibition. Josefsson and Broberg (2011) compared meditators to student controls who had never meditated and found no differences in inhibitory control, as measured by the Stroop task. The authors point out, however, that students likely did not provide a well-matched control group for the meditators. By nature of being college students, controls may have had better than average executive control. They also were younger and may have had more computer experience, which could have been advantageous to their performance on their computer-based administration of the Stroop task.

Effects of Mindfulness Training on Response Inhibition

In addition to evidence suggesting that mindful individuals and meditators demonstrate improved inhibitory control compared to those who are less mindful (e.g., Chan & Wollacott, 2007; Jha et al., 2007, Moore & Malinowski, 2009), research has also shown that mindfulness training can improve elements of executive functioning, including response inhibition, in both participants experienced in mindfulness practices (Sahdra et al., 2011) and in those who had not received prior mindfulness training (Friese et al., 2012; Heeren et al., 2009; Tang et al., 2007; Wenk-Sormaz, 2005). Sahdra and colleagues (2011) evaluated the impact of intensive mindfulness training (i.e., a three-month meditation retreat) on response inhibition among meditators who already had significant meditation experience (i.e., had previously participated in at least three meditation retreats). Participants completed a

computerized response inhibition task (RIT; Sahdra et al., 2011) in which they were required to click their mouse button when a long line appeared on the screen (higher frequency of presentation) but they were not to respond when a short line (lower frequency) appeared. Initially, there were no differences on the RIT between meditators selected for the retreat and those who served as wait-list controls. However, at post-test, only those who participated in the retreat demonstrated significantly improved RIT performance. Further, results were maintained at a five-month follow-up. This suggests that, even among very experienced meditators, additional mindfulness training can precipitate improvements in inhibitory control.

Heeren et al. (2009) compared the response inhibition of healthy individuals who participated in eight weeks of mindfulness-based cognitive therapy (MBCT) to that of matched controls. Neither group had any prior meditation experience. Participants completed the Hayling task (Burgess & Shallice, 1996), which assessed their ability to inhibit a prepotent response. In the Hayling task, participants are required to complete sentences read aloud by the examiner with either an appropriate word (automatic condition; e.g., "the captain wanted to stay with the sinking *boat*") or inappropriate word (inhibition condition; e.g., "the captain wanted to stay with the sinking *laugh*"). Compared to their pre-test scores, at post-test participants who received MBCT both provided more correct responses and made fewer errors, whereas those who did not receive MBCT did not significantly improve, suggesting that mindfulness training improved participants' ability to inhibit dominant responses. However, in the same study, there were no pre- to post-test or between-group differences in

response inhibition as measured by the Trail Making Test (TMT; Reitan, 1958) and a GoStop task (Dougherty, Mathias, & Marsh, 2003).

While not yet examined extensively, available research has also demonstrated effects of mindfulness on response inhibition in more brief mindfulness interventions. Tang and colleagues (2007) randomly assigned students to receive five daily 20-minute training sessions in either mindfulness or progressive muscle relaxation (PMR) and then assessed participants' performance on the conflict monitoring component of the ANT immediately following the final training session. Their results revealed significant group differences in post-test inhibitory control such that those who received mindfulness training demonstrated improved performance on the conflict monitoring component of the ANT, whereas the conflict monitoring performance of those who learned PMR did not change.

Similarly, Wenk-Sormaz (2005) found decreased Stroop interference among mindfulness-naïve undergraduates who received two 20-minute mindfulness trainings and a 20-minute mindfulness induction at post-test, compared to controls. Control groups also participated in practice sessions and the post-test induction: participants in a cognitive control group used a mnemonic device to learn a list of items, while participants in a resting control group practiced resting and allowing their mind to wander. The mindfulness group learned to focus their attention on their breath, without judging themselves when their attention wandered. Interestingly, the author also controlled for the effect of physiological relaxation. Using measurements of participants' galvanic skin response, Wenk-Sormaz (2005) found that only the mindfulness induction resulted in a reduction in physiological arousal, whereas participants in both the resting condition and the learning condition experienced an increase in

arousal. However, arousal did not account for the observed changes in Stroop performance. Further, bivariate correlations between arousal and Stroop performance were not significant for any of the groups. These results demonstrate both that mindfulness can impact response inhibition after a very short period of training and that such changes cannot simply be attributed to changes in physiological arousal.

Finally, Friese and colleagues (2012) found improved performance on a response inhibition task following Day 2 of a three-day introduction to meditation seminar (which heavily emphasized mindfulness-based meditation techniques) and a 5-minute self-directed mindful meditation, compared to participants who attended the meditation seminar but were selected to complete a dot-to-dot drawing task instead of meditation. Friese and colleagues' (2012) results are unique in two ways. First, they provide the only known research that directly evaluates the state-based effects of mindfulness on response inhibition (i.e., all participants attended the meditation seminar, but only some meditated prior to the response inhibition assessment). Second, they assessed participants' inhibitory control under conditions of both depleted and non-depleted self-control resources, whereas prior research has typically been limited to "normal" cognitive conditions. In order to temporarily deplete participants' capacity for self-control, Friese and colleagues (2012) had participants first watch a series of disgusting videos and either suppress their emotions by maintaining neutral facial expressions (suppression condition) or allow themselves to experience their emotions freely (no-suppression condition). Subsequently, participants in the suppression condition either meditated or completed the drawing task, while all participants in the no-suppression condition completed the drawing task. Finally, participants' inhibitory control was measured

via the D2 test of attention. Results revealed that participants in the suppression plus meditation condition exhibited better inhibitory control than those in the suppression without meditation condition, indicating that the response inhibition capacity of those who had cultivated a mindful state was superior to those who were trained in mindfulness but had not intentionally induced it. Further, participants in the suppression plus meditation condition performed as well on the inhibition task as those who were in the no-suppression control condition, which suggests that mindful meditation may have buffered against the depleting effects of emotion suppression and allowed mindful participants to retain their normal capacities for response inhibition. These results are consistent with Heppner et al.'s (2008) finding that, among participants who were provoked (which would also be expected to deplete self-control), those who subsequently participated in a mindfulness exercise were less aggressive than provoked participants who were not mindful. Also like Friese and colleagues' (2012) findings, those in Heppner and colleagues' (2008) mindfulness plus provocation group were no more aggressive than controls who were not provoked at all. Findings from both studies support the notion that mindfulness preserves inhibitory control in conditions of low resources and self-control depletion, which may be an instrumental mechanism in the association between mindfulness and aggression.

As a whole, these findings suggest that inhibitory control can be improved with mindfulness-based interventions, including those that are very brief (Friese et al., 2012; Tang et al., 2007; Wenk-Sormaz, 2005). However, it must be acknowledged that improvements in response inhibition have not been found uniformly. Semple (2010) used random assignment and compared groups of mindfulness-naïve community adults who received mindfulness

training to both a wait-list control group and an active control group, which received relaxation training. Active participants were asked to practice either mindfulness or PMR for 20 minutes twice daily over a period of four weeks, and they participated in an induction of their designated skill prior to post-testing. Expected Stroop practice effects were observed from pre- to post-tests. However, in contrast to Tang et al.'s (2007) results with a shorter intervention, there were no between-groups differences in post-test Stroop performance between mindfulness, PMR, and control participants, indicating that neither mindfulness nor relaxation training significantly improved participants' capacity for response inhibition. Similarly, Anderson, Lau, Segal, and Bishop (2007) found no differences in Stroop performance in their evaluation of the effects of an eight-week MBSR course. However, it is noteworthy that, unlike Semple (2010), there were also no significant improvements in accuracy from pre-test to post-test. The absence of practice effects, which are often observed in assessments of executive functioning (Bartels, Wegrzyn, Wiedl, Ackermann, & Ehrenreich, 2010), suggests that ceiling effects may have prevented participants in this healthy population from incurring meaningful change in rsponse inhibition as a result of mindfulness training, though it should be noted that significant effects of mindfulness have been found in other non-clinical samples (e.g., Jha et al., 2007; Wenk-Sormaz, 2005).

Summary and Conclusions

While some findings have been mixed, the majority of research that examines response inhibition as it relates to mindfulness has shown support for the hypothesis that training in sustained, non-judgmental attention and awareness can improve the capacity for

response inhibition and contribute to the deautomatization of overlearned response patterns. These findings have been demonstrated in comparisons of meditators to controls and in associations with trait mindfulness (e.g., Chan & Woollacott, 2007; Jha et al., 2007; Moore & Malinowski, 2009; van den Hurk et al., 2010). Further, results from mindfulness interventions show that changes in response inhibition can be produced among those previously unexposed to mindfulness techniques, both following extensive training (Heeren et al., 2009) and brief interventions (Friese et al., 2012; Tang et al., 2007; Wenk-Sormaz, 2005).

Currently, however, no known research has examined whether the induction of a mindful state can have immediate, state-based effects on response inhibition for mindfulness-naïve participants. Anderson et al. (2007), Friese et al. (2012), Semple (2010), Tang et al. (2007), and Wenk-Sormaz (2005) all included a mindfulness induction prior to their assessment of executive functioning; however, their participants had all learned and practiced mindfulness techniques prior to response-inhibition assessments. Research on the state-based effects of first-time mindfulness practice is limited, though, existing studies with mindfulness-naïve participants have shown state-based effects on participants' affect (Arch & Craske, 2006; Broderick, 2005; Erisman & Roemer, 2010; Ortner & Zelazo, 2012), ability to de-center (i.e., to view thoughts as mental events rather than reflections of reality; Feldman, Greeson, & Senville, 2010), decision making (McHugh, Simpson, & Reed, 2010), and aggressive behavior (Heppner et al., 2008). The finding that is perhaps most related to the present investigation is that of Hooper, Davies, Davies, and McHugh (2011), who found that a single mindfulness exercise facilitated less spider avoidance compared to control tasks (i.e., thought suppression and unfocused attention) in participants with a fear of spiders. While

they did not assess response inhibition directly, these results suggest that a single mindfulness intervention enabled participants to inhibit a dominant response (spider avoidance), thereby supporting the notion that a mindful state may improve response inhibition abilities, even for those who are not familiar with mindfulness. However, research that explicitly examines its impacts during assessments of response inhibition (e.g., the Stroop task) is needed. This type of research is particularly important in order to determine whether mindfulness has specific state-based effects on response inhibition, or if the superior response inhibition observed among those with higher trait mindfulness and mindfulness experience is better attributed to a more general facilitation of response inhibition which results from repeated mindfulness practice over time.

Research into the effects of mindfulness on executive functioning has also typically focused on changes in healthy populations; however, improvements in executive functioning might also be expected among those with executive functioning deficits. For example, substance abusers, who typically exhibit poor inhibitory control (Groman, James, & Jentsch, 2009; Hoaken, Giancola, & Pihl, 1998), have demonstrated improved Stroop performance following a course of goal management training (GMT; Robertson, Levine, & Manly, 2005) with an added mindfulness component, whereas those who received GMT alone did not show improvements in inhibitory control (Alfonso, Caracuel, Delgado-Pastor, & Verdejo-Garcia, 2011). Additional research is needed to determine whether other populations characterized by poor inhibitory control (e.g., criminal or otherwise aggressive samples) exhibit similar improvements in executive functioning following mindfulness interventions. Given that aggressive behavior is associated with decreased inhibitory control (e.g., Broomhall, 2005;

Cohen et al., 2003) and mindfulness interventions have been shown to decrease aggressive behavior (e.g., Chapman et al., 2013; Fix & Fix, 2013), it is important that changes to inhibitory control be evaluated as a potential mechanism for these changes.

Empirical Associations Between Aggressive Behavior and Response Inhibition

In a meta-analysis of executive functioning studies with antisocial populations specifically, Morgan and Lilienfeld (2000) found a medium to large effect of executive functioning and reported that antisocial individuals performed .62 standard deviations worse than controls on executive functioning tests. Though they did not provide results for various executive functions individually, the authors concluded that executive functioning deficits in general appear to play an important role in aggressive behavior and should continue to be explored in our attempt to understand mechanisms influencing aggression. In other research, specific associations between response inhibition deficits and aggressive behavior have also been well established, both in special populations (e.g., criminal offenders: Broomhall, 2005; Fishbein, 2000; Foster, Hillbrand, & Silverstein, 1993; Hancock, Tapscott, & Hoaken, 2010, and IPV perpetrators: Cohen, Brumm, Zawacki, Paul, Sweet, & Rosenbaum, 2003; Westby & Ferraro, 1999) and in the general population (Denny & Siemer, 2012; Pawliczek et al., 2013), supporting the notion that variations in response inhibition specifically may be key in predicting and mitigating aggressive behavior. Deficits in response inhibition may be especially important in understanding impulsive aggression, such as aggressive behavior which is reflexively engaged in as a response to provocation. However, it is important to note that few studies (e.g., Broomhall, 2005; Villemarette-Pittman et al., 2002) distinguish between

impulsive aggression and aggression which is premeditated and goal oriented (i.e., instrumental).

Response Inhibition of Criminal Offenders

Broomhall (2005) conducted the only known evaluation of executive functioning in criminal offenders that distinguishes between types of aggression. He classified violent male offenders as either predominant reactively aggressive (e.g., impulsive, unplanned aggression) or predominant instrumentally aggressive (e.g., goal-oriented, premeditated aggression) and assessed their executive functioning with a number of measures, including the Color-Word subtest, which is a variation of the Stroop task included in the Delis-Kaplan Executive Functioning System (D-KEFS; Delis, Kaplan, & Kramer, 2001). Results indicated that reactively aggressive offenders performed more poorly than instrumentally aggressive offenders on the inhibition/switching task of the Color-Word test, which required them to say the ink color of the color word, unless there was a box around the word, in which case they were to read the color word and ignore the ink color. There was also a trend for reactively aggressive offenders to perform more poorly on the Color-Word inhibition task, which required them to name the ink color of the color word (which did not match the word itself). These differences suggest that the reactively aggressive offenders had difficulty inhibiting a dominant, overlearned response (i.e., naming the color instead of reading the word), as well as difficulty with flexibly switching mental sets (e.g., following the correct rule on the Color-Word inhibition/switching task).

Hancock and colleagues (2010) identified deficits across several domains of executive functioning in a sample of male inmates, including specific evidence of increased impulsivity and difficulties with response inhibition. Participants completed the D-KEFS Tower Test, which required them to create a given pattern while following a series of specific rules. Results indicated that lower mean first move time, which is an indicator of impulsive responding, was associated with a higher frequency of violent crimes. Further, violent crime severity was associated with slower performance on the inhibition/switching portion of the D-KEFS Color-Word subtest. Together, these results suggest that increased impulsivity and difficulties with response inhibition may contribute to aggressive behavior.

Foster and colleagues (1993) conducted a year-long prospective study in which they tracked the aggressive behavior of male forensic patients who had committed a violent crime. They assessed response inhibition via the Stroop task and the Wisconsin Card Sorting Test (WCST; Heaton, 1981). To complete the WCST, which is typically computer administered, participants are presented with four target cards containing stimuli that vary based on color, shape, and number (e.g., a card may have one red circle or three blue stars). They are then given a deck of similar cards and asked to sort them (by color, number, or shape) in front of the four stimulus cards. After each card is laid (e.g., two red triangles are placed under one red circle because they are the same color), participants are told if they have sorted correctly or incorrectly. After the participant sorts 10 cards correctly (the first sorting rule is color), the sorting rule changes and they are required to figure out the new rule (i.e., sort the cards by shape or number) based on feedback provided to them. Response inhibition deficits are represented by participants' frequency of perseverative errors (i.e., incorrect responses that

follow a discontinued sorting rule). Foster and colleagues' (1993) results indicated that poorer Stroop performance, as assessed at the beginning of the study, predicted more severe and more frequent aggression over the course of the year. In contrast, perseverative errors on the WCST were not associated with patients' aggression. However, Fishbein (2000) reported results from an unpublished data set, in which she found that violent criminal offenders performed more poorly on the Stroop task and the WCST as compared to nonviolent offenders, again suggesting that difficulties with response inhibition may be implicated in aggressive behavior.

Response Inhibition of Intimate Partner Violence Offenders

Cohen, Rosenbaum, Kane, Warnken, and Benjamin (1999) used the WCST and the Adaptive Rate Continuous Performance Test (ARCPT; Cohen, 1993) to compare the executive functioning of male IPV offenders to maritally discordant and non-discordant male controls. The ARCPT is a computerized task that requires participants to identify target stimuli when they follow various specific rules (e.g., press a key for an *X* when it is preceded by the letter *A*). Problems with response inhibition are indicated by ARCPT false-positive errors (i.e., pressing a key when a target stimulus has not been presented). Results provided greater evidence of response inhibition problems among offenders compared to both control groups, as evidenced by the significantly higher number of WCST perseverative errors and ARCPT false-positive errors made by the IPV offenders.

In a subsequent study, Cohen and colleagues (2003) identified a number of tests of executive functioning specifically associated with impulsivity and used them to evaluate the

response-inhibition abilities of male IPV offenders and non-offending male controls. They administered the Stroop task, the TMT, Go/No-Go tasks, the ARCPT, and the Porteus Maze task (Porteus, 1965). The TMT consists of two subtests: Trails A requires participants to draw lines to connect a series of randomly arranged numbers in sequence (e.g., 1, 2, 3), whereas Trails B requires participants to alternately connect numbers and letters (e.g., 1, A, 2, B) in sequence. Because Trails B requires the suppression of an overlearned response (i.e., connect numbers to numbers and letters to letters) in favor of a more novel response; the number of set-loss errors committed can be used as an indicator of impulsive and disinhibited responding. Response inhibition was captured on the Porteus mazes by assessing the number of times a participant crossed a line, which is thought to be indicative of impulsivity and haphazard responding (Porteus, 1965). Results revealed that IPV offenders evidenced more problems with response inhibition than controls on the majority of the tasks, as indicated by more set-loss errors on Trails B, higher Stroop interference scores, more false-positive responses on the ARCPT, and more line crossing on the Porteus mazes. They did not find significant differences between offenders and controls on the Go/No-Go tasks; however, the overall pattern of results suggests that IPV offenders experience significantly more problems with response inhibition than men who do not perpetrate intimate partner violence.

Schafer and Fals-Stewart (2000) recruited couples in which the husbands were recovering from substance use disorders. They measured husbands' capacities for response inhibition using the Stroop task and the TMT. Results revealed that poorer performances on the Stroop task and Trails B were associated with more total couple violence, total husband-to-wife violence, and severe husband-to-wife violence. In another study, Stanford, Conklin,

Helfritz, and Kockler (2007) used the TMT and the WCST to compare the response inhibition capacities of male IPV offenders to nonviolent controls. Their results showed that the offenders made more errors on Trails B and had more failures to maintain set on the WCST, suggesting that they had more problems with impulsive and disinhibited responding than controls.

Westby and Ferraro (1999) examined response inhibition in male IPV offenders compared to age- and education-matched controls without a history of domestic violence. Controlling for alcohol use and cognitive ability, they found that IPV offenders took significantly longer to complete Trails B, which may be attributable to difficulty inhibiting dominant responses. However, offenders did not perform differently than controls on other measures of response inhibition, including the Stroop task and the WCST. Thus, Westby and Ferraro's (1999) results are only partially consistent with research that has found associations between aggression and problems with inhibition in IPV offenders and other populations (e.g., violent offenders).

Finally, Walling, Meehan, Marshall, Holtzworth-Munroe, and Taft (2012) evaluated response inhibition in a sample of community men who had committed IPV, as indicated via self- and partner report, compared to nonviolent maritally discordant controls. In contrast to previous findings, results revealed no response-inhibition differences between offenders and controls as assessed by Trails B and the WCST. However, total and perseverative errors on the WCST were significantly positively correlated with IPV frequency. Further, when the men were grouped into perpetration subtypes (i.e., family only, low-level antisocial, severe borderline dysphoric/generally violent antisocial), the severely violent men made significantly

more total and perseverative errors on the WCST compared to controls. The authors concluded that response inhibition impairments may be most evident in severely violent men as opposed to men with a history of more mild domestic violence.

While there are some exceptions in which differences in inhibitory control were not found between offenders and controls, the majority of findings suggest that males who commit violent offenses perform more poorly on tests of response inhibition than their non-offending counterparts. However, these studies are limited to examining associations between response inhibition and historical acts of violence and aggression. In order to conclude that inhibitory control deficits contribute to aggressive behavior, it is necessary to assess response inhibition prior to assessments of aggressive behavior.

Associations Between Response Inhibition and Aggression in the General Population

In addition to evaluating the effects of response inhibition deficits on aggression in populations characterized by aggressive behavior (e.g., violent criminals, IPV offenders), research has explored these associations in the general population. Such studies have repeatedly shown that self-reported aggressive behavior is associated with response-inhibition deficits on tests of executive functioning (e.g., Denny & Siemer, 2012; Pawliczek et al., 2013). Further, associations between executive functioning deficits and increased aggressive behavior in the laboratory have also been found (e.g., Giancola & Zeichner, 1994; Lau, Pihl, & Peterson, 1995); however, laboratory studies have predominantly evaluated executive functioning more generally and have not assessed differences in aggression related to response inhibition or impulsivity specifically.

Response Inhibition and Self-Reported Aggression

Villemarette-Pittman and colleagues (2002) conducted the only known research to specifically evaluate associations between executive functioning and impulsive aggression (as opposed to aggression more generally) in a general population sample. Using self-report questionnaires to identify male and female undergraduate students who were either impulsively aggressive or non-aggressive, Villemarette-Pittman and colleagues (2002) found that impulsively aggressive students performed more poorly on tests of executive functioning than controls. However, assessments of response inhibition were not included in their evaluation of executive functioning, so these findings cannot be extended to response-inhibition deficits more specifically.

Giancola, Roth, and Parrott (2006) also found an association between executive functioning and self-reported aggression and, unlike Villemarette-Pittman and colleagues (2002), they included assessments of response inhibition (i.e., Stroop, Trails B, WCST) in their executive functioning assessment battery. Results indicated that lower overall performance across measures of executive functioning was associated with greater self-reported physical aggression on the AQ for both males and females. However, because the authors did not present separate results for each assessment of executive functioning, conclusions about the unique associations between response inhibition and aggression cannot be drawn from.

Denny and Siemer (2012) administered a Go/No-Go task in which male and female undergraduate students were to respond as quickly as possible to frequent target stimuli while inhibiting responses to less frequent, non-target stimuli. Angry and happy faces were

alternately used as the target and non-target stimuli. Denny and Siemer (2012) found that participants' total scores on the AQ were associated with poorer response inhibition when the angry faces were used as the non-target stimuli; however, aggression was unrelated to participants' response inhibition to happy faces. They concluded that higher trait aggression might only be associated with problems with response inhibition in response to anger-related cues, suggesting that response inhibition deficits in aggressive individuals may exist primarily in the context of provocation. One possible interpretation of these findings is that the response inhibition abilities of aggressive individuals do not differ from those of non-aggressive individuals until they are provoked, at which time aggressive individuals' capacity for response inhibition is depleted.

Pawliczek et al. (2013) conducted a similar study in which male students responded to angry and neutral faces, unless a yellow border appeared around the face, in which case they were instructed to inhibit their response. Participants high in trait aggression, based on their total scores on the AQ, had more difficulty inhibiting responses to non-target stimuli. Interestingly, in contrast to Denny and Siemer's (2012) findings, both the high and low aggression groups were better at inhibiting responses to angry faces than to neutral faces. These findings are consistent with others that suggest that aggressive individuals have more difficulty with response inhibition in general, and they do not support Denny and Siemer's (2012) theory that response inhibition differences may only be present in the context of provocation.

Together, these studies of response inhibition associations with self-reported aggression suggest that individuals who report higher levels of trait aggression and aggressive

behavior exhibit significantly greater deficits in response inhibition. However, these studies are correlational in nature and do not assess response inhibition at the time of aggressive behavior. Accordingly, these findings cannot be used to draw conclusions about individual differences in response inhibition in the context of aggressive behavior. It may be that aggressive individuals exhibit poorer response inhibition across contexts compared to less aggressive individuals. However, as Denny and Siemer's (2012) findings might suggest, aggressive individuals may only have problems with response inhibition in the context of provocation or other cues for aggressive behavior. In order to evaluate whether aggressive individuals' capacity for response inhibition is depleted by provocation and whether this contributes directly to aggressive behavior, response inhibition and behavioral assessments of aggression must be assessed together in the context of provocation.

Response Inhibition and Aggression in the Laboratory

In the laboratory setting, Hoaken, Shaughnessy, and Pihl (2003) evaluated associations between executive functioning and aggression in mixed-gender samples of undergraduates and healthy community adults. Participants who performed in the high and low quartiles on two assessments of executive functioning, the Spatial Conditional Associative-Learning Tasks (SCALT; Petrides, 1985) and Self-Ordered Pointing Tasks (SOP; Petrides & Milner, 1982), were asked to complete the entire study. Response inhibition was measured using a Go/No-Go discrimination task prior to participants' completion of the TAP. Participants in the lower quartile for executive functioning delivered significantly more intense shocks than those in the high quartile, and they made more errors on the Go/No-Go task, which was non-

significant but trending. The authors did not provide results for associations between aggressive behavior and response inhibition on the Go/No-Go task; however, these overall results indicate that individuals with generally poor executive functioning abilities both demonstrate more difficulties with response inhibition and a greater propensity for impulsive aggression than those with generally strong executive functioning abilities.

Santor, Ingram, and Kusumakar (2003) evaluated the effects of executive functioning on verbal aggression in a sample of community adolescents. Participants first completed two tests of executive functioning that primarily measure active monitoring in working memory: the Conditional Associative-Learning Tasks (CALT; Petrides, 1985) and SOP tasks. Subsequently, participants participated in a modified version of the TAP in which they ostensibly competed in a visual search task and sent and received verbal messages of varying offensiveness (i.e., degrees of provocation). Results revealed that executive functioning moderated the relationship between provocation and verbal aggression. When faced with *increasingly* offensive comments from their opponents, those with lower executive functioning abilities responded with more aggression than those with higher executive functioning abilities. However, verbal aggression was unrelated to executive functioning abilities when opponents administered *decreasingly* offensive verbal messages. This suggests that executive functioning deficits may predispose individuals to aggressive behavior, but only when provoked.

Giancola and Zeichner (1994) used a similar study design with a sample of community men. Participants first completed CALT and SOP tasks, followed by the TAP. Men who performed poorly on CALT tasks were more aggressive (i.e., delivered more intense shocks)

than those who performed well; however, this relationship was not observed with SOP tasks. Giancola and Zeichner (1994) did not evaluate the effects of provocation. Finally, in a third study of this kind, executive functioning was represented by a composite of community men's CALT and SOP performances, and deficits in these domains were found to significantly predict aggression on the TAP (Lau et al., 1995). While these results do not directly evaluate the effect of inhibitory control on aggressive behavior, they do demonstrate a relationship between executive functioning deficits and actual aggressive behavior, observed in the laboratory, in the context of a non-clinical population. It is important to extend this research to response inhibition specifically in order to determine whether inhibitory control impacts aggressive responding directly at the time of provocation.

Summary and Conclusions

Research that utilizes behavioral assessments of aggression is limited; however, there is strong support in retrospective and self-report studies to demonstrate that aggressive behavior is associated with response-inhibition deficits, both in groups characterized by aggression (Broomhall, 2005; Fishbein, 2000; Foster et al., 1993; Hancock et al., 2010; Westby & Ferraro, 1999) and in samples from the general population (Denny & Siemer, 2012; Pawliczek et al., 2013). Based on these studies, it appears that we can conclude that aggressive individuals tend to have more difficulties inhibiting automatic responses, which may contribute to their tendency to be aggressive. Nevertheless, these studies are essentially correlational in nature; we know that aggressive individuals tend to have poorer inhibitory control, but we don't know that response inhibition deficits contribute causally to aggressive

behavior. To answer this question, aggressive behavior needs to be assessed behaviorally in the context of experimentally manipulated response inhibition. If aggression is shown to vary based on the degree of experimentally manipulated response inhibition, we could more confidently conclude that inhibitory control has a causal effect on aggressive behavior. Presently, no known studies of this kind exist.

Summary and Present Study Objectives

In conclusion, mindfulness-based interventions are being increasingly used to reduce aggressive behavior; however, the mechanisms through which increases in mindfulness are associated with reductions in aggression are not well understood. Extant research suggests that mindfulness-induced alterations to inhibitory control might be a potential mechanism for this effect; however, prior research has not empirically evaluated this hypothesis. Further, while correlational associations between deficits in response inhibition and aggression have been well established, available research does not demonstrate whether this relationship is causal. Finally, experimental studies have shown that mindfulness-based interventions can improve response inhibition, yet the amount of mindfulness training necessary to induce such effects has not been established. It may be that effective inhibitory control is a component of state mindfulness, in which case extensive training in mindfulness would not be necessary to produce improvements in response inhibition. Rather, temporary inhibitory control enhancements might be experienced as the result of a single successful mindfulness induction. In order to address these gaps in the extant literature and to evaluate inhibitory control as a potential mediator of the relationship between mindfulness and aggressive behavior, the

present study evaluated whether a single mindfulness induction could produce improvements in inhibitory control and whether such improvements have a subsequent impact on participants' likelihood of behaving aggressively in response to provocation.

Hypothesis 1

Prior research has demonstrated that mindful individuals, including those who are experiencing mindfulness for the first time (e.g., Heppner et al., 2008), display less impulsive aggression following provocation than participants who are not mindful. Accordingly, Hypothesis 1 predicted that participants who were exposed to a mindfulness induction would engage in less impulsive aggression in response to provocation compared to controls.

Hypothesis 2

In previous studies, participants who received brief mindfulness training and then participated in a mindfulness induction demonstrated superior response inhibition compared to controls (e.g., Friese et al., 2012; Wenk-Sormaz, 2005). Accordingly, Hypothesis 2 predicted that subjects who participated in a mindfulness induction, without the brief mindfulness training, would exhibit better response inhibition than controls, controlling for baseline differences in response inhibition.

Hypothesis 3

It has been argued that deficits in response inhibition can contribute to aggressive behavior, and individuals who behave aggressively have been repeatedly shown to exhibit

poorer inhibitory control than non-aggressive participants (e.g., Cohen, 1993). Accordingly, Hypothesis 3 predicted that participants' capacity for response inhibition would predict aggressive behavior in the context of provocation.

Hypothesis 4

Extant research indicates both that mindfulness can improve inhibitory control and that inhibitory control deficits are associated with aggressive behavior (Cohen, 1993; Wenk-Sormaz, 2005). As such, between-groups differences (i.e., mindfulness versus control) in response inhibition following a mindfulness induction were expected to mediate the relationship between state mindfulness and aggressive behavior.

Research Question

Prior research has not evaluated the differential impact of state mindfulness on aggression at increasing levels of provocation. Individuals typically respond to increasing levels of provocation with increasing aggression (e.g., Santor et al., 2003). However, given the tendency toward non-judgment and acceptance inherent in mindfulness, mindful individuals might be expected to show low levels of aggressive responding, regardless of the level of provocation experienced. Accordingly, mindful individuals might exhibit a significantly less drastic increase in aggressive behavior in response to increasing provocation, as compared to individuals who are not mindful (i.e., controls). However, it may also be that mindful individuals respond to provocation with less aggression overall but are equally impacted by increases in provocation as are non-mindful individuals. To evaluate

these possibilities in the present study, between-groups changes in aggression in response to increasing provocation were compared. However, because no prior research is available to support either of these potential outcomes, no *a priori* hypothesis about the nature of the relationship was made.

CHAPTER 2

METHOD

Participants

Participants were recruited from introduction to psychology courses at Northern Illinois University and were awarded course credit for participation. All of the students had the option to participate in mass testing, a large in-person survey conducted at the start of each semester and used to screen students for participation in various studies. Participants were invited to participate in the present study based on their responses to mass-testing questions regarding age (all participants were 18-25 years of age), gender (only males were recruited), color-blindness (participants with color-blindness were excluded) and aggressive behavior (only aggressive individuals were invited). Participation was restricted to individuals 18-25 in order to obtain an emerging adulthood sample, which minimizes potential age effects on executive functioning. Individuals who had prior experience with mindfulness (e.g., through therapy, yoga, or meditation) were also excluded; however, prior experience was assessed *after* participation in the study in order to avoid priming effects.

Gender differences are to be expected with regard to aggressive behavior (e.g., Giancola et al., 2006; Hoaken et al., 2003), often necessitating that assessments of associations between aggressive behavior and other constructs be conducted separately for men and women. Historically, research on aggression and inhibitory control has been

conducted primarily with men, and there is more empirical support for these associations among men than women (e.g., Broomhall, 2005; Cohen et al., 2003; Hancock et al., 2010). Therefore, in order to avoid the potential need to split the sample and conduct analyses separately for each gender, only male students were invited to participate.

Prior research suggests that the hypothesized effects of mindfulness and response inhibition on aggressive behavior are present in the general population (e.g., Giancola et al., 2006; Heppner et al., 2008). However, empirical support for associations between mindfulness and aggression and inhibitory control and aggression is stronger in aggressive populations (e.g., criminals and IPV offenders) and those high in trait aggression than for the general population overall (e.g., Cohen et al., 2003; Hancock et al., 2010; Pawliczek et al., 2013; Wupperman et al., 2012). Further, because research has established that trait-aggressive individuals have poorer inhibitory control than those who are not more aggressive than average (e.g., Denny & Siemer, 2012; Pawliczek et al., 2013), only aggressive individuals were included in an attempt to prevent ceiling effects from potentially minimizing the hypothesized effect of mindfulness on inhibitory control.

Sample Size

In the only known study to evaluate the effect of a mindfulness induction on aggressive behavior for mindfulness-naïve participants, Heppner et al. (2008) found a significant effect of mindfulness with a sample size of 60, with 20 participants in each of three groups; however, Heppner and colleagues (2008) did not report effect size estimates. With regard to the association between mindfulness and response inhibition, significant effects of

mindfulness have been found with group sizes $n = 40$ (Tang et al., 2007), $n = 33$ (Friese et al., 2012), and $n = 40$ (Wenk-Sormaz, 2005). Of these studies, only Friese et al. (2012) published estimates of effect size, indicating a medium-size effect ($d = .54$) for the relationship between mindfulness and inhibitory control when mindfulness is induced in the laboratory (based on Cohen's [1988] guidelines for determining a small, medium, and large effect). Because the present study is the first known evaluation of the impact of inhibitory control on aggressive behavior measured in the laboratory, no estimates of effect size were available for determining the appropriate sample size. However, medium-size effects ($r = .33$-$.37$) have been found for the association between executive functioning more generally and aggressive behavior in the laboratory with a sample of $N = 72$ (Giancola & Zeichner, 1994). Further, small ($r = .26$; Denny & Siemer, 2012) to medium ($\eta^2 = .13$; Pawliczek et al., 2013) effects have been found for associations between self-reported aggression and inhibitory control with sample sizes of $N = 112$ and $N = 33$, respectively.

Fritz and MacKinnon (2007) provide recommended sample sizes for mediation based on the significance test to be used and the expected effect sizes of the alpha and beta paths of the mediation. The only published effect size for the alpha path (the relationship between mindfulness and inhibitory control when mindfulness is induced in the laboratory) suggested that a medium effect size ($d = .54$) could be expected in the present study. Estimates for the beta path (the relationship between inhibitory control and aggressive behavior in the laboratory) were not available; however, similar studies suggested that a medium effect might be expected. When a medium effect is expected for both the alpha and beta paths, Fritz and

MacKinnon (2007) recommend a sample size of 71 to achieve power = .80 with a bias-corrected bootstrap test of significance.

To determine the sample size necessary for the proposed analyses of covariance (ANCOVA), which were used to evaluate Hypothesis 2 (i.e., that the individuals in the mindfulness group would perform better on the measure of response inhibition than the controls, controlling for their response inhibition at baseline), a power analysis was conducted using G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). To achieve power = .80 to detect a medium effect size (d = .54) with an alpha= .05, the recommended sample size was N = 103. Based on these sample size recommendations, a sample size of N = 104 was sought.

Sixteen hundred thirty-one participants completed mass testing. Of those, 231 met the requirements described above and were invited to participate. One hundred fifteen participants completed the full study. Data for 14 participants were excluded due to participant and experimenter errors during data collection. Twenty-eight participants were removed because of prior experience with yoga, mindfulness, and/or meditation. Finally, data from eight participants who reported low levels of paying attention, following directions, and attending to the breath during the manipulation were excluded. Data from 65 participants were included in the final analyses. After the data were cleaned, the group sizes remained roughly equal, with 35 participants in the control group and 30 participants in the mindfulness group.

Self-Report Measures

Demographic Questionnaire

Participants completed a short demographic questionnaire, that assessed individual differences including age, race/ethnicity, family income, and education (Appendix A). Participants ranged in age from 18 to 25, with a mean age of 19 years old (*SD* = 1.48). Thirty-one participants identified as Caucasian (48%), 22 identified as African American (34%), 5 identified as Hispanic/Latino (8%), 2 identified as East Asian/Asian American (3%), and 5 participants self-identified as multi-racial or other (8%).

Aggression Questionnaire (AQ)

The AQ (Buss & Perry, 1992) is a 29-item self-report measure of aggression, including estimates of physical aggression, verbal aggression, hostility, and anger. Participants use a 5-point Likert scale to indicate the degree to which they believe each statement describes them, from 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me). Higher scores correspond with greater aggression, anger, and hostility. A total score for the AQ has been used widely to distinguish between high and low trait aggressiveness (Pawliczek et al., 2013) and to attempt to quantify trait aggressiveness more generally (Denny & Siemer, 2012). However, confirmatory factor analysis results have demonstrated that the items do not reliably load onto one overall factor (Bryant & Smith, 2001). Similarly, the 29 items have not been found to consistently load onto their intended factors (Bryant & Smith, 2001; Vigil-Colet, Lorenzo-Seva, Codorniu-Raga, & Morales, 2005;

Williams, Boyd, Cascardi, & Poythress, 1996). Accordingly, Bryant and Smith (2001) caution against calculating a total score for the AQ. Instead, they recommend the use of individual subscale scores and a shortened 12-item version of the AQ, which includes the three highest loading items for each factor, identified using principal components analysis. Bryant and Smith (2001) also advocate for altering the Likert scale from 5 to 6 points in order to require participants to identify whether each characteristic is more like or unlike them, as opposed to allowing them to select a neutral midpoint. They evaluated the goodness of fit for their new short form in three different samples and concluded that the 12-item measure with a four-factor model is a significant improvement over the 29-item, one-factor model and provides an appropriate measurement model for the AQ. Bryant and Smith (2001) demonstrated that the subscales of the AQ-SF have good internal reliability (physical aggression: $\alpha = .80$, verbal aggression: $\alpha = .80$, anger: $\alpha = .76$, and hostility: $\alpha = .80$).

Given the poor fit of the factor structure of the original AQ and space limitations with regard to the number of items that could be administered at mass testing, Bryant and Smith's (2001) short form of the AQ (AQ-SF, Appendix B) was utilized in the present study. Participants' total scores on the three-item physical aggression subscale (3. Given enough provocation, I may hit another person, 8. There are people that pushed me so far that we came to blows, and 11. I have threatened people I know), which they completed during mass testing, were used to determine students' eligibility for participation.

Acceptable internal consistency was found for the verbal aggression ($\alpha = .76$), anger ($\alpha = .66$), and hostility ($\alpha = .72$) subscales in the present sample. However, the internal consistency for the physical aggression subscale was unacceptably low ($\alpha = .08$). This

suggests that the three items included in the physical aggression subscale may be assessing different components of physical aggression that are not necessarily correlated for the participants in this sample. As a result, the AQ-SF may not have captured a subsample of the mass-testing participants who have similar histories of aggressive behavior. The poor reliability of the physical aggression subscale also calls participants' commitment to the mass-testing assessment into question. That is, it is tempting to attribute the poor reliability of the physical aggression subscale to participants not taking the assessment seriously. However, the reliability of the other subscales was much greater and in the acceptable range, which indicates that careless or random participant responding is likely not the reason for the poor physical aggression subscale reliability. Regardless of the cause of the poor reliability, higher physical aggression subscale scores do represent greater endorsement of aggressive behavior, so participants' mean physical aggression subscale scores were used to determine eligibility as planned. Participants who scored above average ($M = 7.05$ for the present sample) on the AQ-SF physical aggression subscale were invited to participate.

Manipulation Check Questionnaire

In order to evaluate whether participants followed instructions and participated in the manipulation as instructed, and to ensure that the TAP deception operated as expected, participants were asked various questions about how they experienced each task. Questions about prior experience with mindfulness and meditation were also included in the manipulation check questionnaire (Appendix C).

All of the participants were asked the question, “How much were you paying attention to the recording?” On a scale from 1 (Not at all) to 8 (Very much), participants had a mean response of 5.40 (*SD* = 1.39), with a median response of 6, suggesting that they were generally attempting to focus on the recording. Participants in the mindfulness group also answered questions pertaining specifically to the mindfulness manipulation. Using the same scale for the question, “How much did you attempt to follow the directions in the recording?” participants provided a mean response of 6.13 (*SD* = 1.55) and median response of 6.0, indicating that the majority of them were diligent in attempting to follow instructions. Participants in the mindfulness group were also asked, “How much of the time do you think you were actually focused on your breathing during the exercise?” On a scale from 1 (None at all) to 8 (The entire time), participants had a mean response of 4.80 (*SD* = 1.27) and a median response of 5. Individuals are not expected to be able to focus on their breathing for the duration of a focused breathing exercise. Rather, the objective is to *attempt* to focus on one’s breathing and non-judgmentally return one’s attention to the breath upon realizing the mind has wandered. Accordingly, the median response of 5, which suggests that the participants were at least attempting to focus on their breath, is consistent with what would be expected from a focusedbreathing induction.

When asked, “How confident were you that you were competing against a ‘real’ opponent?” participants provided a mean response of 3.28 (*SD* = 2.04) and a median response of 3 on a scale from 1 (Not at all) to 8 (Very much). The language in the question, which was asked after the task was completed, primed participants to be skeptical about the veracity of the competition they had completed, which could have influenced them to report less

confidence than they had actually experienced during the task. However, the fact that the modal response was 1 (n = 17) suggests that the deception was not successful for many of the participants. As a result, participants may not have been adequately provoked to behave aggressively.

Laboratory-Based Measures

Taylor Aggression Paradigm (TAP)

Aggression was assessed with a modified version of the TAP (Taylor, 1967), a widely used and well-validated analog measure of aggressive behavior (Bernstein, Richardson, & Hammock, 1987; Giancola & Zeichner, 1995). In the TAP, participants ostensibly compete one-on-one with another participant in a reaction-time task, in which the winner of the task delivers an aversive stimulus (e.g., shock, noise blast) to the loser. However, the opponent is fictional, and the outcome of each trial (i.e., win versus loss and the intensity of the stimuli delivered to a participant upon a loss) is fixed and predetermined by the experimenter.

The TAP was administered in conjunction with the Stroop task via the computer-based research program SuperLab 4.5 (Cedrus Corporation, San Pedro, CA). Specifically, the standard reaction-time task (which requires participants to depress a key until cued to release it in an attempt to release the key more quickly than their opponent) was replaced by a block of trials of the Stroop task. Aside from this substitution, the standard administration of the TAP was not altered.

At the outset of each round of the TAP, participants selected the degree of loudness (i.e., intensity) of a noise blast that would be delivered to their opponent in the event that the

opponent were to lose the competition for that round (i.e., when the opponent ostensibly responded more slowly and with more errors on the Stroop trials). After each round of the TAP, participants either received a blast of noise or they were shown the level of noise blast their opponent selected for them to receive.

While the original TAP utilized shocks as the aversive stimulus, more recent modifications deliver aversive stimuli in the form of white-noise blasts in order to minimize the risk of harm to participants (Bushman & Baumeister, 1998; Heppner et al., 2008). Consistent with recent studies (e.g., Bushman & Baumeister, 1998), the range of noise-blast volume participants received ranged from 65 decibels (level 2) to 100 decibels (level 9), increasing by five decibels for each level of intensity. Participants were given the opportunity to send noise blasts corresponding with levels 1-10; however, they never received a level 1 or level 10 blast. The specific stimulus used for the noise blasts was selected from a standardized set of emotionally evocative stimuli (Bradley & Lang, 2007) for its exceptionally low pleasure rating (M =2.42, SD = 1.62) and high arousal rating (M =7.98, SD = 1.62) on 9-point scales of pleasure and arousal.

Consistent with more recent modifications of the original structure of the TAP (Wallace & Taylor, 2009), the administration of the TAP consisted of one initial round, three sets of four rounds (corresponding with low-, moderate-, and high-intensity noise blasts received from the opponent), and one transition round between the low and moderate and moderate and high sets, for a total of 15 noise-blast rounds. Thus, participants made15 determinations of the level of noise blast their opponent would receive upon a loss. Participants “won” the initial round, “lost” the two transition rounds, and “won” 50% of the

remaining rounds. However, in order to maintain the deception that participants were competing against an opponent, participants "lost" any round in which they took an exceptionally long time to respond (e.g., due to distraction from the task), regardless of whether a win or loss was predetermined for that round.

In the first set of TAP rounds (low provocation), the noise-blast intensity set by the "opponent" varied from 65 decibels (level 2) to 70 decibels (level 3). Second-set (moderate provocation) rounds included blasts ranging from 80 decibels (level 5) to 85 decibels (level 6), and third-set (high provocation) rounds included blasts ranging from 95 decibels (level 8) to 100 decibels (level 9). Participants received noise blasts of 75 decibels (level 4) and 90 decibels (level 7) at the end of the first and second transition rounds, respectively. Transition rounds were included to allow the increase in provocation to appear more gradual while also allowing the level of provocation in each set to be distinct.

The dependent measure of aggression is the average noise-blast intensity selected by the participant across Rounds 2 through 15. The noise-blast intensity selected during the first round was not included in the intensity score because participants selected it in the absence of provocation. Accordingly, the first-round noise blast is not an adequate measure of reactive aggression, which is the specific type of aggression of interest in the present study.

Stroop Task

A computer-adapted version of the Stroop task (Stroop, 1935) was administered as a measure of participants' capacity for response inhibition. The Stroop task, which has been described as a "prototypical" (Miyake et al., 2000, p. 57) and "canonical" (Teper & Inzlicht,

2013, p. 1) measure of response inhibition, has repeatedly shown strong reliability and validity across a wide variety of populations and variations in administration (Macleod, 1991). During the Stroop task, a trial consists of a color word (i.e., red, yellow, blue, and green) being presented on a computer screen that participants respond to by using a color-coded keypad to indicate the color of the ink in which the word is printed. In congruent trials, the color of the ink matches the word (e.g., "red" printed in red ink). In incongruent trials, the color of the ink does not match the word (e.g., "yellow" printed in blue ink). Participants also name the colors of neutral stimuli (i.e., XXX printed in red, yellow, blue, or green ink). Finally, the Stroop task also typically includes word-reading trials, in which the color words are printed in black ink (e.g., "yellow," "red," and "blue" all printed in black ink) and participants are asked to simply read the word rather than name the ink color).

In the present study, participants completed the Stroop task twice: once at the beginning of the study in order to obtain a baseline estimate of inhibitory control and once following the mindfulness/control manipulation. The second administration of the Stroop task was combined with the TAP.

During the baseline administration of the Stroop task, participants first completed a block of 30 word reading trials (i.e., 30 color words, presented one at a time, in black ink) in order to obtain an estimate of each participant's reading fluency. They then completed a block of 90 trials that included congruent (30 trials), incongruent (30 trials), and neutral (30 trials) color-naming stimuli, presented in a seemingly random order. Participants' mean response times are presented in Table 1.

Table 1

Mean Response Times by Trial Type and Condition

	Control *M(SD)*		Mindfulness *M(SD)*	
Baseline neutral trials	741.45	(101.77)	791.17	(96.98)
ST neutral trials	733.61	(115.47)	756.38	(90.47)
Baseline congruent trials	770.08	(107.74)	836.08	(112.19)
ST congruent trials	640.46	(94.28)	691.86	(99.93)
Baseline incongruent trials	889.51	(150.40)	965.16	(126.33)
ST incongruent trials	741.45	(150.55)	786.39	(141.69)

Note. Control $n = 35$; Mindfulness $n = 30$. ST = Stroop/Tap procedure.

During the combined Stroop/TAP task, participants completed a mixed block of 30 Stroop trials during each of the 15 rounds of the TAP, for a total of 450 trials. Each mixed block contained 10 congruent trials, 10 incongruent trials, and 10 neutral trials, presented in a seemingly random order. Black-ink word reading trials were not included in the second administration of the Stroop task.

In both administrations of the Stroop task, each word remained on the screen until the participant responded. The dependent measures of response inhibition are participants' interference scores (i.e., the degree to which the dominant word reading response interferes with the ability to name ink colors) and number of errors made during incongruent trials, where more errors and greater interference represent poorer inhibitory control. Errors during neutral and congruent trials are not included in the error calculation because they do not require participants to inhibit dominant word reading responses and, as such, do not operationalize inhibitory control. For the baseline estimate of response inhibition, each of the 90 baseline Stroop trials were included in the error and interference score calculations.

However, the post-induction estimate of response inhibition was calculated using only the trials from the first round of the Stroop/TAP procedure. Upon completion of these first 30 Stroop trials, participants had not yet won or lost a trial, or received a noise blast, thus minimizing any effect receiving the noise blasts may have had on participants' capacity for response inhibition. Participants' mean response times during the first round of the Stroop/Tap procedure are presented in Table 1.

Two interference scores were calculated. First, an incongruent-neutral interference score (I-N interference) was calculated by subtracting participants' average response time across neutral stimuli from their response time across incongruent stimuli. This is the most standard practice for calculating Stroop interference (Macleod, 1991), and it provides a measure of response inhibition by indicating the decrease in participants' color-naming performance when having to inhibit a dominant reading response, compared to their color-naming performance in the absence of a competing response. Second, an incongruent-congruent interference score (I-C interference) was calculated by subtracting participants' response time across congruent stimuli from their response time across incongruent stimuli. In this method of calculating interference (Josefsson & Broberg, 2011; Teper & Inzlicht, 2013), a dominant response pattern (i.e., word-reading) is activated in both conditions, but it is only detrimental to performance in the incongruent condition. In order to avoid errors and name colors efficiently across trials, participants must inhibit the dominant word-reading response each time, including during congruent trials. The I-C interference score provides an estimate of participants' response inhibition across trials in which a competing response is activated.

Procedure

After mass testing, email invitations were issued to eligible participants, inviting them to participate in the full study. Invitations included a password that granted participants permission to schedule participation in the study via Sona Systems (Sona Systems, Ltd., 2014), an online subject-pool management program. Informed consent was obtained both at mass testing and in the laboratory, prior to participation in laboratory-based tasks (Appendix D).

Participation in the laboratory took approximately one hour. Participants were seated, alone, in a quiet room. In order to obtain a baseline estimate of participants' capacity for response inhibition, they first completed the Stroop task, independent of the TAP.

Next, participants were randomly assigned to participate in either a mindfulness-based breathing activity or a control activity. Random assignment was conducted separately for White and non-White participants in order to ensure a roughly equal number of minority participants in each group. While mindfulness can be experienced in a variety of formats, the most common practice for experimentally inducing mindfulness involves guiding participants to focus their attention on their experience of breathing (e.g., Arch & Craske, 2006; Broderick, 2005; Erisman & Roemer, 2010; Hooper et al., 2011; Wenk-Sormaz, 2005). Accordingly, participants in the mindfulness condition listened to an audio recording that introduced mindfulness and guided them through a 20-minute, non-judgmental, focused breathing exercise. The introduction and guided breathing exercise (Appendix E) were adopted from transcripts published by Erisman and Roemer (2010) and Wenk-Sormaz (2005),

respectively. The exercise was intended to induce a state of mindfulness through the intentional, non-judgmental focused attention on the present-moment experience of breathing.

Consistent with control conditions included in other mindfulness induction studies (e.g., Arch & Craske, 2006; Heppner et al., 2008; Hooper et al., 2011; Wenk-Sormaz, 2005), participants in the control group were asked to sit quietly, allow themselves to relax, and let their minds wander. However, in order to more closely match the conditions of the mindfulness induction, the control participants also listened to a 20-minute audio recording in the form of a selection of classical music.

Following the experimental manipulation, participants completed the combined Stroop and TAP task. Participants then completed the manipulation check and demographic questionnaire, which was administered via online survey software. Finally, participants were given a list of local counseling resources they could use in the event that they experienced negative psychological outcomes related to participation. In order to preserve the deception in the TAP, full debriefing was conducted via email at the conclusion of each semester of data collection.

CHAPTER 3

RESULTS

Data Preparation and Overview of Analyses

No missing data were detected. The TAP data were normally distributed and no outliers were detected. The response time data were prepared according to recommendations by Ratcliff (1993, 2013). For every participant, the distributions of response times for each response time condition (e.g., baseline incongruent Stroop trials, congruent Stroop/TAP trials) were separately evaluated for outliers. For each of these distributions, response times greater than two standard deviations above the mean were removed prior to calculating participants' mean response times for each trial type (i.e., neutral, congruent, and incongruent trials at baseline and during the Stroop/TAP). Baayen and Milin (2010) suggested that response times of less than 5 ms after a stimulus is presented are physically impossible, and Luce (1986) demonstrated that true responses typically require at least 100 ms to perform. Given these guidelines, one extremely low response time (4 ms) was also removed.

Boxplots and stem-and-leaf charts were used to identify between-subjects outliers for participants' mean response times, number of errors, and interference scores. Because response times for long, spurious responses were removed at the trial level prior to computing participants' mean response times for each condition, outlying high mean response times likely represented participants who genuinely required a long time to respond to the Stroop

trials. In other words, since long individual trials (e.g., long response times due to distraction) were removed, high mean response times represent participants who consistently required more time than most to respond to the Stroop trials. Accordingly, outlying mean response times were replaced with the nearest non-outlying values in their distributions in order to reduce their effects on analyses without removing them altogether, which would have misrepresented group means by unduly lowering them. Likewise, the same procedure was used for outlying errors and interference scores, thereby reducing the effects of these outliers without removing them from the data. Participants' inhibitory control at baseline and during the first round of the combined Stroop/TAP task are represented by three different scores: incongruent trial errors, I-N interference, and I-C interference. For Hypotheses 2 through 4, each score was evaluated in separate analyses.

Hypothesis 1

Hypothesis 1 proposed that participants assigned to the mindfulness induction would behave less aggressively in response to provocation than controls. However, results of an independent-samples *t* test indicate that the noise blasts issued by participants in the mindfulness group ($M = 6.29$, $SD = 2.19$) did not differ in intensity from those issued by the control participants ($M = 6.25$, $SD = 1.97$), $t(63) = -.06$, $p = .95$, $d = -.02$.[1]

[1] Analyses were also conducted using participants' maximum noise blast issued as the dependent variable; however, results did not differ from those found using participants' average noise blast score.

Hypothesis 2

Hypothesis 2 proposed that participants assigned to the mindfulness condition would exhibit better response inhibition than those assigned to the control condition, while controlling for participants' baseline capacity for response inhibition. A series of one-way ANCOVAs, in which participants' response inhibition scores during the combined Stroop/TAP task (i.e., I-N interference, I-C interference, and incongruent trial errors) were compared between groups while controlling for their baseline inhibitory control scores. There were no significant between-groups differences for I-N interference, $F(1, 62) = .12$, $p = .74$, $\eta_p^2 < .01$, or I-C interference, $F(1, 62) = .11$, $p = .74$, $\eta_p^2 < .01$. Across groups, baseline I-N interference, $F(1, 62) = 5.85$, $p = .02$, $\eta_p^2 = .09$, and I-C interference, $F(1, 62) = 14.18$, $p < .001$, $\eta_p^2 = .19$, were significant predictors of Stroop/TAP I-N and I-C interference scores, respectively. An evaluation of participants' errors on incongruent Stroop trials revealed that, across groups, the number of errors participants made at baseline was a significant predictor of errors made during the combined Stroop/Tap task, $F(1, 62) = 11.90$, $p = .001$, $\eta_p^2 = .16$. Group was also a significant predictor of errors; however, the effect was in the opposite direction than expected. Participants in the mindfulness group made more errors on the incongruent trials than those in the control group, $F(1, 62) = 5.52$, $p = .02$, $\eta_p^2 = .08$ (see Table 2 for means), when controlling for baseline errors.

Table 2

Mean Interference Scores, Errors, and Difference Scores by Condition

	Control *M(SD)*		Mindfulness *M(SD)*	
Baseline I-N interference	142.03	(94.40)	173.99	(81.28)
ST I-N interference	7.54	(127.41)	30.01	(112.48)
I-N difference	134.50	(137.38)	143.98	(113.85)
Baseline I-C interference	115.73	(81.55)	129.08	(68.44)
ST I-C interference	94.45	(117.52)	94.53	(144.64)
I-C difference	21.27	(117.71)	34.55	(121.58)
Baseline incongruent trial errors	1.11	(1.21)	1.10	(1.45)
ST incongruent trial errors	.40	(.65)	.80	(.85)*
Error difference	.71	(1.18)	.30	(1.29)

Note. * $p = .04$. Control $n = 35$; Mindfulness $n = 30$. ST = Stroop/Tap procedure.

Hypothesis 3

Hypothesis 3 proposed that participants' capacity for inhibitory control would predict aggressive behavior in the context of provocation. To test this hypothesis, a series of regression analyses were conducted in which participants' mean noise blast scores were regressed onto their response inhibition scores from the combined Stroop/TAP task (i.e., I-N interference, I-C interference, and incongruent trial errors). Results indicated that, across measures of inhibitory control, participants' capacity for response inhibition did not significantly predict TAP scores (see Table 3).[2]

[2] Analyses were also conducted using participants' maximum noise blast issued as the dependent variable; however, results did not differ from those found using participants' average noise blast score.

Table 3

Standardized and Unstandardized Regression Coefficients for Measures of Inhibitory Control as Predictors of Aggression

	b	*SE b*	*ß*
I-N interference	<.001	.002	-.03
I-C interference	-.002	.002	-.10
Incongruent trial errors	-.28	.34	-.11

Note. I-N interference: R^2 = .001, F (1, 63) = .05, p = .82. I-C interference: R^2 = .01, F (1, 63) = .58, p = .45. Incongruent trial errors: R^2 = .01, F (1, 63) = .70, p = .41.

Hypothesis 4

Hypothesis 4 proposed that between-groups differences (i.e., mindfulness versus control) in response inhibition following the mindfulness induction would mediate the relationship between laboratory-induced mindfulness (compared to a control condition) and aggressive behavior. A bias-corrected bootstrap resampling technique via the statistics macro PROCESS (Hayes, 2013) was used to test the significance of the indirect effects of response inhibition (e.g., I-N interference, I-C interference, and incongruent trial errors) on the relationship between condition (mindfulness or control) and noise blast intensity. In accordance with Mallinckrodt, Abraham, Wei, and Russell's (2006) recommendations, ten thousand bootstrap resamples were conducted and used to test the indirect effects. Estimates of the impact of the indirect effect were insignificant for all three models, as indicated by the presence of zero in the 95% confidence intervals of the bootstrap estimate of each effect (see Table 4). Unstandardized coefficients of each path are presented in Figure 1.

Table 4

Mediation Analyses for Evaluating the Indirect Effect of Response Inhibition on the Relationship Between Mindfulness and Aggression

Mediator	*Boot*	*SE*	*CI*
I-N interference	-.01	.07	-.20 – .11
I-C interference	.02	.08	-.09 – .31
Incongruent trial errors	-.12	.16	-.53 – .13

Note. SE = standard error. CI = confidence interval.

Research Question

In order to determine whether mindful and control participants responded to increasing levels of provocation differently, a two-way repeated-measures ANOVA was conducted, comparing the aggression of the two groups (mindfulness and control) at each level of provocation (low, moderate, and high). Consistent with prior studies, the main effect of provocation was significant, $F(2, 126) = 17.27$, $p < .001$, $\eta_p^2 = .22$, meaning that the intensity of noise blasts issued by participants varied based on level of provocation. The main effect of condition was not significant; noise blasts issued by participants in the mindfulness group did not differ significantly from those issued by controls across levels of provocation, $F(1, 63) = .01$, $p = .92$, $\eta_p^2 < .001$. Further, the interaction between condition and provocation was not significant, $F(2, 126) = .31$, $p = .73$, $\eta_p^2 = .01$, indicating that the mindful and control groups responded similarly to the effects of provocation.

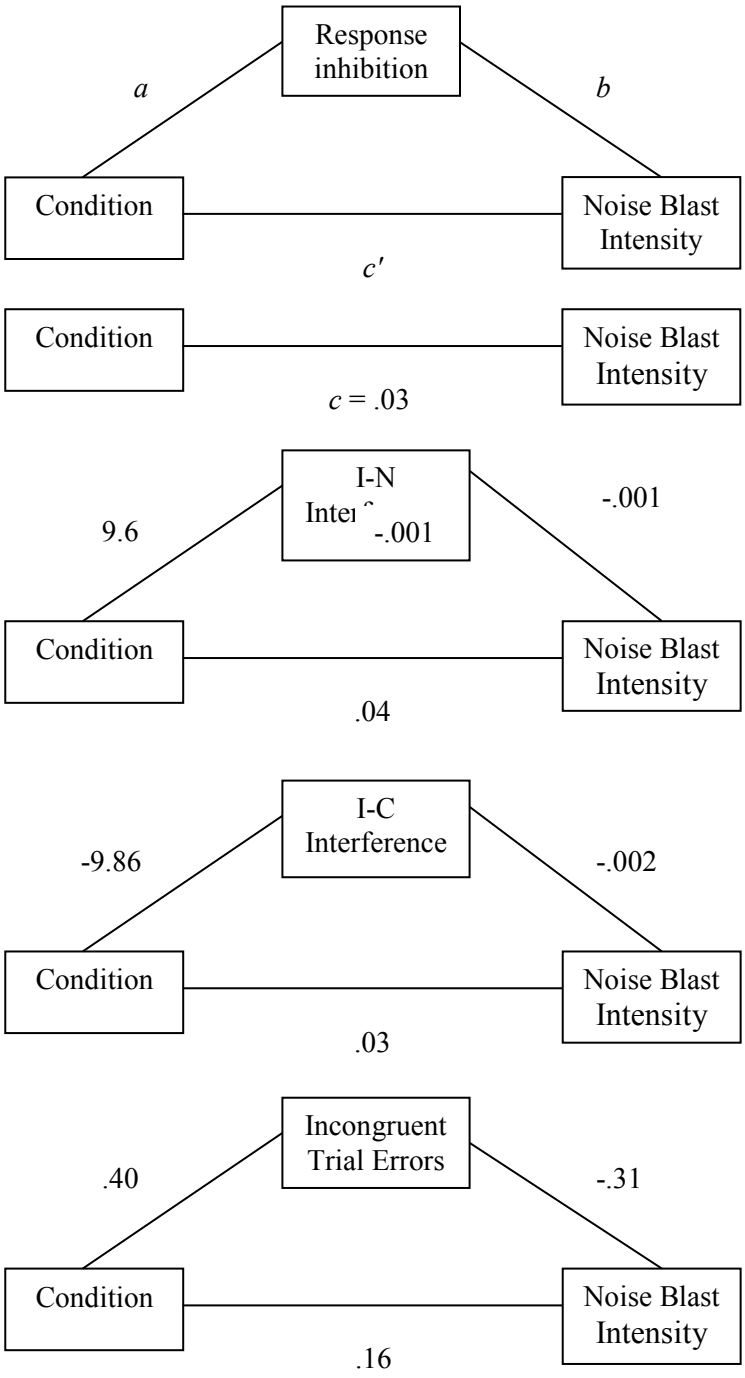

Figure 1. Unstandardized Beta Coefficients for Paths in Analyses of the Indirect Effects of Measures of Inhibitory Control on the Effect of Mindfulness on Aggression. *p = .02.

CHAPTER 5

DISCUSSION

This study evaluated whether a single, brief mindfulness induction would have immediate, state-based effects on aggressive behavior and whether, if present, such effects would be partially explained by mindfulness-induced changes in inhibitory control. A focused breathing exercise was used to induce mindfulness in a sample of mindfulness-naive male undergraduates, whose performances on an inhibitory control task and aggression paradigm were then compared to that of a control group.

Mindfulness-based interventions have been repeatedly linked to reductions in aggressive behavior (e.g., Chapman et al., 2013, Fix & Fix, 2013; Samuelson et al., 2007), presumably due to increases in trait mindfulness. However, trait mindfulness is difficult to assess and mindfulness-based interventions include many active components, making it difficult to determine whether increased mindfulness has a direct effect on reductions in aggression. Heppner and colleagues (2008) conducted the first known study in which aggressive behavior was assessed following an experimental manipulation of state mindfulness. They found that participants who completed a mindfulness induction behaved less aggressively than those who did not participate in the induction, suggesting that state mindfulness has a direct effect on aggressive behavior. Further, Heppner and colleagues' (2008) results suggest that just one experience with mindfulness can have immediate effects on aggressive behavior among those with no prior mindfulness experience.

However, in contrast to Heppner et al.'s (2008) findings and Hypothesis 1, results in the present study indicated that participants assigned to the mindfulness group were no more, or less, aggressive than controls, suggesting that the mindfulness induction did not impact participants' propensity for aggressive behavior in response to provocation. Thus, either mindfulness was not effectively induced, or it had no impact on aggressive behavior in the present study. It may be that the focused breathing exercise was not effective at inducing mindfulness in this sample or that other factors (e.g., participant stress) interfered with their ability to be mindful. On the other hand, it may be that participants did not experience mindfulness because, contrary to what Heppner and colleagues' (2008) findings suggest, it cannot be meaningfully induced during a brief, one-time experience. Finally, it may be that mindfulness was successfully induced in one or both of these studies but that mindfulness does not impact aggressive behavior without additional training and practice. Such an argument supports the idea that repeated mindfulness practice causes an increase in trait mindfulness, and it is this trait-based change that ultimately impacts behavior (e.g., Samuelson et al., 2007).

It is important to note a key limitation in both Heppner and colleagues' (2008) study and the present research. Due to a lack of available measures for assessing state mindfulness (Tanay & Bernstein, 2013), neither study included a manipulation check to assess whether mindfulness had actually been induced as a result of the procedure. Instead, both relied on a control-group comparison to identify the effects of a standard mindfulness induction and assumed that such effects would be due to the experience of state mindfulness. However, when taking this approach, it is important that the experience of participants in the control

condition be as closely matched to that of the mindfulness condition as possible. Accordingly, the control participants in the present study completed an activity that was similar to those in the mindfulness group (i.e., participants in both groups listened to a 20-minute recording in the same quiet room), but it did not include key elements of a mindfulness induction (i.e., focused attention). In contrast, the experience of the mindfulness and control participants in Heppner and colleagues' (2008) study was very different. The raisin-eating task that they used for a mindfulness induction was directive and active, whereas their control participants simply waited quietly and did not participate in any additional activity. The lack of similarity between the mindfulness and control groups participants' experience is especially relevant because, unlike the present study, the participants in Heppner and colleagues' (2008) study were provoked before the mindfulness induction, not after it. In Heppner and colleagues' (2008) study, participants experienced a social rejection prior to the mindfulness induction, following which they were given the opportunity to behave aggressively on the TAP, toward those who had rejected them. Thus, the activity that preceded the social rejection (i.e., waiting or doing the raisin eating task) would have influenced how they processed the experience of being rejected. Heppner and colleagues (2008) argued that the mindfulness induction mitigated the distress participants experienced as a result of the rejection, which then lessened their propensity to behave aggressively toward those who rejected them. However, it is important to consider the effect waiting quietly had on the control participants. During the 20-minute quiet wait period, participants would have had the opportunity to ruminate about the rejection, potentially increasing their experience of distress, as well as their desire to behave aggressively toward those who rejected them. Thus, the two groups may have differed

because the control participants' propensity to behave aggressively increased, rather than because the mindfulness induction had a mitigating effect on aggression.

Hypothesis 2, which proposed that mindfulness would be associated with better response inhibition, was not supported. Specifically, participants' interference scores, calculated based on their response time during the first block of the Stroop portion of the TAP, did not differ between groups, indicating that the mindfulness induction did not produce the predicted improvement in participants' ability to inhibit word-reading behavior in favor of color-naming. Interestingly, despite random group assignment, participants in the mindfulness group exhibited poorer response inhibition compared to controls at baseline. This finding emphasizes the importance of controlling for pre-existing group differences; if baseline interference had not been included as a control, between-groups differences may have been found and erroneously attributed to the effects of the mindfulness induction.

ANCOVAs are useful for evaluating between-groups differences in treatment effects while controlling for baseline functioning, but ANCOVAs and descriptive statistics alone do little to illustrate the magnitude of treatment effects. To better understand the magnitude of between-groups differences, participants' mean interference scores can be used to calculate difference scores (i.e., baseline interference – Stroop/TAP interference; see Table 2). These demonstrate that for both I-N and I-C interferences the mindfulness group exhibited greater improvement following the induction than the control group. These differences are not significant (I-N interference, $t(63) = -.30$, $p = .77$, $d = .08$; I-C interference, $t(63) = -.45$, $p = .66$, $d = .11$), but they show that the effect of the mindfulness intervention was in the

predicted direction, even though participants in the mindfulness group experienced more interference than controls both at baseline and during the TAP.

In contrast to the null findings with regard to interference, the errors made by the mindfulness and control groups differed significantly, in the opposite direction of what was expected. Participants in the mindfulness group made more incongruent trial errors than controls during the Stroop/TAP task, controlling for incongruent trial errors during the baseline assessment of the Stroop. Consistent with this, difference scores for incongruent trial errors show that the control group experienced greater reduction in the number of errors committed from pre- to post-test. This difference is also not statistically significant ($t(63) = 1.35$, $p = .18$), though the effect size ($d = .33$) suggests it may be meaningful.

Does this difference in error rate suggest that the mindfulness condition was actually harmful to participants' inhibitory control? To answer this question, it is important to understand what Stroop trial errors are thought to represent. On incongruent trials, an error is typically the result of reading the word (e.g., "blue") instead of naming the ink color the word is printed in (e.g., red ink). Incongruent trial errors serve as a measure of response inhibition because they represent the ability to inhibit word reading in favor of color naming. In contrast, congruent and neutral trials do not require that a dominant response (i.e., word reading) be inhibited, so errors on these trials are not attributed to poor inhibitory control. Accordingly, the mindfulness group's higher error rate on the incongruent trials should only be attributed to poorer response inhibition if the groups' error rates differ only on incongruent trials, and do not differ on neutral and congruent trials. If the mindfulness group also made more errors on other trials which are not typically indicators of problems with inhibition, then their errors

might be better attributed to other factors (e.g., carelessness or rushing). Follow-up testing of congruent and neutral trial error rates between groups suggest that this was the case in the present study. Participants in the mindfulness group (M = .37, SD = .49) also made more congruent-trial errors than controls (M = .14, SD = .36), $F(1, 62) = 4.51$, $p = .04$, $\eta_p^2 = .07$, when controlling for baseline congruent trial errors. Mindfulness participants (M = .47, SD = .73) and controls (M = .57, SD = .70) did not differ significantly in the number of errors made on neutral trials, $F(1, 62) = .34$, $p = .56$, $\eta_p^2 = .01$. Thus, because the mindfulness group's increased error rate was not limited to the incongruent trials, it would be inappropriate to conclude that the between-groups difference is due to differences in response inhibition.

What might have caused the mindfulness group to make more errors overall? One possibility is that the inherent difficulty in complying with the instructions of the mindfulness induction (i.e., maintain focus on your breath) depleted their feelings of self-efficacy and left them feeling stressed or anxious, which then carried over to their participation in the Stroop/TAP task, resulting in more errors. To evaluate this possibility, participants' responses to the manipulation check question, "How much anxiety/distress did you feel during the competition?" were assessed. Results indicated that the level of anxiety/distress self-reported by participants in the mindfulness group (M = 2.80, SD = 1.58) was actually lower than the anxiety/distress reported by controls (M = 3.43, SD = 1.50). This difference approaches a trend, $t(63) = 1.64$, $p = .11$, and the effect size suggests that the difference is meaningful, d = .41. Thus, the mindfulness induction does not appear to have contributed to errors via increased distress. In fact, the results are more in line with the opposite. Consistent with the Yerkes-Dodson law, it is possible that the mindfulness participants' stress level was too low

for them to perform their best, whereas the control groups slightly higher experience of stress may have helped them minimize errors.

Another possibility is that participants in the mindfulness group were dedicating cognitive resources to being mindful, which then resulted in them having a higher cognitive load than controls. If this were the case, then maintaining mindfulness and completing the Stroop/Tap task would have been competing for cognitive resources and could have left the mindfulness participants at a disadvantage over the controls. Speculations can be made, but there is no obvious explanation for why participants in the mindfulness group made more errors than controls. Further, because this effect is in the opposite direction than theory would suggest, it would be inappropriate to conclude that the mindfulness induction was responsible for this difference unless these findings were to replicate in future studies. Rather, it is more likely that there was some other unidentified difference between the groups, despite randomization, that was responsible for the higher error rate among participants in the mindfulness group.

In contrast to prior research and Hypothesis 3, the non-significant relationships between interference scores on the Stroop/TAP and noise blasts issued on the TAP suggest that response inhibition was not related to aggressive behavior in the present study. However, prior research that has identified such associations has been conducted almost exclusively with antisocial samples (e.g., violent criminals: Broomhall, 2005; Fishbein, 2000; IPV perpetrators: Cohen et al., 2003; Westby & Ferraro, 1999). Thus, it may be that response inhibition deficits are characteristic of highly aggressive individuals, and associations between response inhibition and more mild aggression are not present in the general population.

Given this possibility, an aggressive subsample of undergraduates was sought for the present study. The short form of the AQ (Bryant & Smith, 2001) has not been used frequently in published research; therefore, it is difficult to determine how the level of aggressiveness reported in the present study compares to aggression reported by antisocial individuals and those in the general population. In the present study, the mean AQ-SF physical aggression subscale score from the overall male undergraduate sample surveyed during mass testing was 7.05. This score is consistent with an average AQ-SF physical aggression subscale of 7.60 reported by Hornsveld, Muris, Kraaimaat, and Meesters (2009) for a sample of Dutch male adolescents. Further, for the final sample in the present study, the mean AQ-SF physical aggression subscale score was 10.91, which is higher than the scores of 8.58 and 9.31 that Hornsveld et al. (2009) reported for inpatient and outpatient violent male offenders, respectively. This suggests that aggression reported in the present sample is comparable to the aggression reported by violent offenders, despite the sample being drawn from an undergraduate population. Thus, the failure to find significant associations between response inhibition and aggressive behavior in the present sample should not be attributed specifically to low levels of trait aggression.

However, there are many factors other than aggression (e.g., socioeconomic status, life stress) that distinguishes the undergraduate sample in the present study from the antisocial samples in prior research. It may be that these factors affect participants' baseline levels of inhibitory control or moderate the relationship between response inhibition and aggressive behavior. Alternatively, aggression may only be associated with response inhibition when it is poor, whereas at high levels of inhibitory control, variations in aggressive behavior are

attributable to other factors. If this were the case, and if undergraduates were found to have generally better response inhibition than antisocial individuals, it could explain the failure to replicate the association between inhibitory control and aggression in the present study, despite similar levels of aggressiveness.

Most prior research has found that trait-aggressive individuals have less inhibitory control than non-aggressive individuals regardless of whether provocation is present (e.g., Cohen et al., 2003; Westby & Ferraro, 1999). However, in one of the only known studies that evaluated the association between aggression and response inhibition in a general population sample, Denny and Seimer (2012) found that higher trait aggression was associated with poorer response inhibition in the context of provocation, but it was unrelated when response inhibition was measured in response to non-provoking stimuli. In the present study, the measure of response inhibition was drawn from the first block of Stroop trials completed during the Stroop/TAP, which participants completed prior to receiving the provoking noise blasts. Thus, consistent with Denny and Seimer's (2012) findings, it might be that interference scores were unrelated to aggressive behavior because the participants were not provoked. However, follow-up analyses of participants' Stroop performance during the high-provocation rounds of the TAP suggest that this was not the case. There was not a significant correlation between noise blast intensity issued during the high-provocation rounds and participants' I-N interference scores, $r(65) = .12$, $p = .33$, or I-C interference scores, $r(65) = .10$, $p = .44$, for Stroop trials completed during high-provocation rounds. Hence, even in the context of strong provocation, participants' inhibitory control was unrelated to their aggressive behavior in the present study.

Finally, it is important to note that the present research is the first of its kind to evaluate the association between response inhibition and aggression in which both are assessed behaviorally in the laboratory. A few studies have found that more problems with executive functioning predict greater aggression on the TAP; however, these studies did not evaluate inhibitory control specifically (Giancola & Zeichner, 1994). Prior research linking inhibitory control and aggression has relied on self-report measures of trait aggression or criminal history (e.g., Denny & Siemer, 2012; Pawlizcek et al., 2013), rather than assessing aggressive behavior with a laboratory analog measure, such as the TAP. Accordingly, this is the first known study able to assess whether inhibitory control capacity predicts aggressive behavior. The fact that participants' performance across measures of response inhibition did not predict the level of aggression they engaged in on the TAP suggests that, while there may be associations between aggression and inhibitory control (e.g., violent criminals often have poor executive functioning), response inhibition may not be a direct predictor of aggressive behavior.

Some interesting patterns emerged when examining the Stroop/TAP data. First, for both groups, Stroop/TAP I-C interference scores (i.e., participants' average response time on incongruent Stroop trials minus their average response time on congruent trials) were higher than Stroop/TAP I-N interference scores (i.e., incongruent response time minus neutral response time). Typically, participants complete neutral trials (i.e., Xs printed in colored ink) the fastest, followed by congruent trials (e.g., "red" in red ink), with incongruent trials (e.g., 'red" in blue ink) requiring the longest time to respond to (Macleod, 1991). Accordingly, I-N interference scores are typically higher than I-C interference scores. This typical pattern is

what was found for participants' baseline interference scores. However, during the Stroop/TAP, participants completed the congruent trials more quickly than the neutral trials, resulting in higher I-C interference scores. This is known as a facilitation effect (Macleod, 1991). In this case, having the matching word for the color (e.g., "red") presented along with the color (e.g., red ink) enhances the ability to quickly identify the color of the ink, perhaps through a priming effect. Theories differ as to how the Stroop task is processed (Macleod, 1991); however, some argue that participants read the word automatically and then must consciously choose to identify the ink color. In this case, when the word matches the ink color, participants are primed for the ink color, making naming it easier than if they had seen Xs and then had to identify their ink color without being primed by the word. While the facilitation effect is noteworthy, it is important to recognize that, because it was found across groups, it does not impact the validity of conclusions regarding the effect of the mindfulness induction.

Another interesting pattern in the Stroop/TAP data was that a large number of participants had negative I-N interference scores (n = 31) and I-C interference scores (n = 17) for the first block of the Stroop/TAP. Negative scores were also found at baseline (I-N interference, n = 3; I-C interference, n = 1), but the quantity was much fewer and less unusual. Participants have negative interference scores when their average response time on incongruent Stroop trials is faster than on congruent or neutral trials. While some atypical data is to be expected (i.e., the four negative baseline interference scores), the fact that almost half of the I-N interference scores and more than a quarter of the I-C interference scores for the Stroop/TAP were negative is highly unusual. This is inconsistent with data typically obtained

from the Stroop task and the theory behind it (Macleod, 1991) and suggests that the Stroop data may not be valid. However, it may be that the 10 trials of each type, included in the first block of the Stroop, were not enough to provide sufficient data for obtaining a reliable estimate of participants' response inhibition.

To evaluate this possibility, interference scores were calculated using all of the Stroop/TAP trials (i.e., data from each round of the TAP). When all the trials were included, there were only two negative I-N interference scores and two negative I-C interference scores. This indicates that, across the entire Stroop/TAP procedure, the Stroop operated as expected. Thus, the interference scores calculated based on the first Stroop/TAP block might simply not be representative of participants' overall Stroop performance. However, when analyses were re-run with these overall Stroop/TAP interference scores, the conclusions did not change. Therefore, while the interference scores calculated using only the first block of the Stroop/TAP may not be reliable estimates of participants' inhibitory control, it appears that the conclusions drawn regarding the absence of a relationship between response inhibition and aggressive behavior in the present study are valid.

Hypothesis 4 proposed that inhibitory control would mediate the relationship between mindfulness and aggression. Given that the predicted relationships between mindfulness and aggression, mindfulness and response inhibition, and response inhibition and aggression were not significant, it is not surprising that the models of the indirect effects were also non-significant. Of note, in two of the models (I-N interference and incongruent trial errors as mediators), the direct effect (*c'*) was larger than the total effect (*c*). The *c* paths were also opposite in sign (positive) to the indirect effect (*ab* was negative). As a result, when the

indirect effects were subtracted from the total effect (i.e., $c - -ab = c'$), the remaining direct effects were larger than the total effect. Fritz and MacKinnon (2007) refer to this as inconsistent mediation, which may indicate a suppression effect. In this case, the inconsistent mediation occurred because the unstandardized regression coefficients for the relationships between response inhibition and TAP scores were negative, despite their correlations being positive. As a result, the indirect effects (*ab*) for the I-N interference and incongruent trial error models are negative while the *c* paths are positive. However, because the main effects in the mediation models were not significant (except the case of the mindfulness group making significantly more errors than controls) and a mediation effect would not be expected, the presence or absence of a suppression effect is not of interest.

The research question explored whether participants in the mindfulness group would respond differently than the controls to increases in provocation. Participants typically respond to increasing provocation during the TAP (i.e., receiving increasingly loud noise blasts) by issuing increasingly loud noise blasts to their opponent, as was the case for participants in both groups for the present study. However, given the mindset of non-judgment and acceptance cultivated by mindfulness practice, it was thought that participants in the mindfulness group might have been less impacted by the increasing provocation and consequently might not have exhibited the increase in retaliatory noise blast volume that is typically observed. Yet, given the lack of differences in overall aggressive behavior between groups, it is not surprising that there was not a significant interaction between group and level of provocation.

In summary, for each hypothesis made, the null hypothesis cannot be rejected. The only significant finding was that participants in the mindfulness group made more errors on the Stroop task than controls; however, this finding was in the opposite direction, as was expected, and was not consistent with results for the other assessments of inhibitory control (i.e., I-N and I-C interference). Together, these findings indicate that the associations found between mindfulness, response inhibition, and aggression in prior research were not replicated in the present study.

However, it is important to acknowledge the many differences between the samples, study designs, and hypotheses in existing research compared to those in the present study. For one, the present study utilized a more general sample than the specific samples (e.g., offenders and meditators) used in most of the reviewed studies. Further, the present study assessed for mindfulness-based effects after a single mindfulness induction with mindfulness-naïve participants, whereas the majority of prior research looked at aggression and response inhibition among those who were very experienced with mindfulness. Finally, much of the reviewed research has focused on inhibitory control as it relates to trait aggression and mindfulness, rather than as it relates to aggressive behavior and state mindfulness, which was the focus of the present research. Thus, the present findings suggest that the relationships between mindfulness, response inhibition and aggression identified in the extant research may not generalize across populations. Rather, they may only be valid in the context of extensive mindfulness practice and trait-based increases in mindfulness, and mindfulness may be most effective at reducing aggression for those who exhibit highly aggressive behavior. Thus, it may be more appropriate for future research to evaluate response inhibition as a mechanism

for the relationship between mindfulness and aggression in the context of treatment study of mindfulness-based interventions for violent behavior.

Limitations in the present study must be considered. First, the present study was underpowered, and small group sizes limit the power to detect true effects. However, given the absence of effects in this study, it is unlikely that having a larger sample would have changed outcomes. The study is further limited by participants' low confidence that they were competing against a real opponent during the TAP, which suggests that the deception and provocation may not have been successful, thus threatening the internal validity of the study. If participants did not actually experience the TAP tasks as provoking, their noise blast scores may not be a valid indicator of their aggressive behavior, which limits the ability to draw conclusions regarding the way mindfulness and response inhibition impact aggressive behavior in the context of provocation. As discussed previously, there is also some concern that the first block of the Stroop portion of the Stroop/TAP did not operate as expected; however, results did not differ when analyses were conducted using all of the data from the Stroop/TAP.

An additional limitation is that, as noted above, one of the screening measures used to determine participant eligibility did not perform as expected, which suggests another threat to the internal validity of the study. Specifically, the alpha level of the AQ-SF physical aggression subscale (Bryant & Smith, 2001) was very poor (α = .08), indicating that the three items included in the subscale were not measuring the same underlying construct. Thus, it may be that participants' subscale scores may not have been a valid indicator of their trait aggression. This would support the conclusion that results were not found, in part, because

mindfulness only reduces aggressive behavior for those who are highly trait aggressive. However, it should be noted that the items included in the AQ-SF physical aggression subscale ask specifically about how characteristic different aggressive behaviors are of the respondent, making it more a measure of observable aggressive behavior than of an underlying construct of trait aggression. Thus, the fact that the scale had poor internal consistency does not change the fact that men who scored higher were identifying more strongly with aggressive behaviors, indicating that the poor subscale internal consistency is likely not the reason why significant findings were not identified. .

Finally, perhaps the biggest limitation in the present research is the inability to determine whether findings from prior research were not replicated because they do not generalize to the specific context of this study (i.e., mindfulness-naïve participants, aggressive behavior rather than trait aggression, response inhibition as opposed to executive functioning more generally) or rather because the mindfulness induction simply was not effective. A brief, one-time induction of mindfulness was chosen for the present research in order to attempt to isolate the specific effects of mindfulness from other outcomes of mindfulness-based treatment; however, one exposure to mindfulness may not have been sufficient for any mindfulness-based effects to manifest. The specific procedure for inducing mindfulness in the present study may also have been problematic. Participants may have been more able to follow along with the instructions and access a state of mindfulness if the focused breathing exercise had been led by an instructor in the room with them, rather than administered via a recording.

Typically, manipulation checks are used to determine whether any type of induction is successful. However, there has been widespread disagreement regarding how to assess mindfulness (Chiesa, 2012), and assessing state mindfulness has been particularly problematic (Tanay & Bernstein, 2013). The Toronto Mindfulness Scale (TMS; Lau et al., 1995) has been widely criticized because it measures decentering and curiosity, which are not core components of mindfulness (Tanay & Bernstein, 2013). Further, the TMS is designed to assess state mindfulness specifically in experienced participants. The State Mindfulness Scale, which has shown promise in its initial validation studies, had only been validated in Hebrew in an Israeli sample at the time data was collected in the present study (Tanay & Bernstein, 2013). Valid and reliable assessments of state mindfulness are critical to the quality of future research on the effects of state mindfulness and their development should be a priority in mindfulness research.

An important strength of the present research is its experimental design. Established associations between mindfulness and response inhibition are primarily based on correlational data, and no prior research had assessed the effect mindfulness has on response inhibition and then evaluated response inhibition as a predictor of aggressive behavior. Instead, the relationship between response inhibition and aggressive behavior has been established through studies where trait aggression and violent offending has been used to predict inhibitory control. This suggests that aggressive behavior may be characterized by poor response inhibition but does nothing to establish causality. To address these issues, the present study used an experimental design to assess the impact mindfulness has on inhibitory control and then evaluate their effects on aggression. Results indicated that, in this study, mindfulness

did not predict response inhibition, and neither predicted aggressive behavior. Thus, while poor inhibitory control is common among aggressive individuals and violent offenders, decreased inhibitory control may not be causing their aggressive behavior. Further, more research is needed to determine the amount of mindfulness training necessary for outcomes commonly attributed to mindfulness to be observed.

Neither prior research nor the present study can fully answer the questions of whether increases in trait mindfulness are independently capable of improving inhibitory control and/or decreasing aggression, as well as whether these effects are more robust when a mindful state is cultivated. That is, maybe state mindfulness does have unique effects on response inhibition and aggressive behavior, but a level of trait mindfulness is required for participants to access a mindful state and experience these outcomes. Future research might evaluate these questions using an experimental design similar to the one employed in the present study, but modified to include several sessions of mindfulness training for participants prior to random assignment to a mindfulness induction or control procedure and the assessment of state-based effects. With a design that includes mindfulness-naïve controls, trait-mindful controls, and a mindfulness induction group that has had prior mindfulness training, researchers could evaluate the state-based effects of mindfulness following an induction in a sample that would be more likely to access a mindful state, given their prior exposure.

Mindfulness is in the zeitgeist, reaching far beyond mental health treatments. It has been applied in schools, government, athletics, and big business. Its explosive growth is largely due to the positive impact those who have adopted mindfulness have experienced in their own lives. When mindfulness is embraced as a way of living, true transformation in the

way one experiences the world can occur. At its core, living mindfully is about treasuring the here and now and allowing judgment, worry, and psychological pain to fall away. It is easy to see ways in which the ripple effects of mindfulness may be endless.

The question is, can mindfulness stand the test of time? And is it the panacea it has been billed as? The answers to both questions will depend on what quality research can teach us about the way mindfulness operates and the direct effects it has on the human experience. How do we operationalize mindfulness for research? What is the required dose for effects? What direct effects does it have, and what apparent outcomes work through indirect processes? Does it work for some better than others? And if so, what qualities determine its differential effects? When the fervor over mindfulness dies down, it will be research that determines whether mindfulness is worthy of all the excitement it has generated and whether it will become a more permanent part of our culture or be relegated to a passing fad. The present research explored some of these questions by attempting to isolate the effects of mindfulness from other associated outcomes and evaluating its effectiveness with a single dose. One may conclude that the absence of relationships between mindfulness and aggressive behavior is evidence that the effects of mindfulness are not as global as they are claimed to be and its effects are more nuanced than is typically acknowledged. However, another equally plausible and possibly incompatible conclusion is that mindfulness is a skill that must be practiced and honed before true change can occur and simply trying mindfulness for a first time may not provide the exposure necessary for its effects to be present. A great deal more research is necessary to fully understand mindfulness and the nature of the impact it has on executive functioning and aggression.

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APPENDIX A

AGGRESSION QUESTIONNAIRE, SHORT FORM

Aggression Questionnaire, Short Form

Instructions: Please read the following statements and use the scale to indicate how characteristic each statement is of you.

1	**2**	**3**	**4**	**5**	**6**
Extremely uncharacteristic of me					**Extremely characteristic of me**

1. I often find myself disagreeing with people.
2. At times I feel I have gotten a raw deal out of life.
3. I have threatened people I know.
4. I wonder why sometimes I feel so bitter about things.
5. I have trouble controlling my temper.
6. My friends say that I'm somewhat argumentative.
7. I flare up quickly but get over it quickly.
8. Given enough provocation, I may hit another person.
9. I can't help getting into arguments when people disagree with me.
10. Other people always seem to get the breaks.
11. There are people who pushed me so far that we came to blows.
12. Sometimes I fly off the handle for no good reason.

APPENDIX B

DEMOGRAPHIC QUESTIONNAIRE

Demographic Questionnaire

Instructions: Please answer the following demographic questions about yourself.

1. What is your age? ____

2. How would you classify yourself?
   ___ African/African American
   ___ Caucasian
   ___ Hispanic/Latino(a)
   ___ East Asian/Asian American
   ___ Native American Indian
   ___ Pacific Islander
   ___ Indian
   ___ Multiracial or other Please Specify _____

3. What is the approximate annual income of your family of origin (e.g., your parents combined income)?
   ___ Below $20,000
   ___ $20,000-$40,000
   ___ $40,000-$60,000
   ___ $60,000-$80,000
   ___ $80,000-$100,000
   ___ $100,000-$150,000
   ___ Over $150,000

4. How many semesters of college have you *completed*? (If this is your first semester, please enter '0') _____

5. As far as you know, have you ever received any of the following therapies or participated in the following activities: (check all that apply)
   __ Mindfulness-based Stress Reduction
   __ Mindfulness-based Cognitive Therapy
   __ Acceptance and Commitment Therapy
   __ Dialectical Behavior Therapy
   __ Any other therapy in which mindfulness or meditation skills were taught
   __ None of the above

6. Have you ever participated in either of the following activities?
   __ Meditation - If yes, please indicate how often you meditate (either currently or in the past)
   __ Yoga - If yes, please indicate how often you have practiced yoga (either currently or in the past)

APPENDIX C

MANIPULATION CHECK QUESTIONNAIRE

Manipulation Check Questionnaire

Instructions: Please answer the following questions about the **20-minute audio-recording**. Your answers will not affect your credits for the experiment, nor will they be seen by anyone other than the experimenter. It is important that you answer as honestly as possible.

1. How much were you paying attention to the recording?

   Not at all – 1 2 3 4 5 6 7 8 – Very much

2. Is there anything that you believe that may have negatively impacted your ability to fully benefit from the exercise? For example, are you feeling especially stressed, distracted, or ill? If so, please describe:

   _____

   ADDITIONAL COMMENTS? *Please provide below*.

   _____

Additional questions to be given only to participants in the mindfulness group (to be included between questions 1 and 2):

1. How much did you attempt to follow the directions in the recording?

   Not at all – 1 2 3 4 5 6 7 8 – Very much

2. How much of the time do you think you were actually focused on your breathing during the exercise?

   None at all – 1 2 3 4 5 6 7 8 – 100% of the time

3. Please indicate your agreement with the following statements:

   3a. When I realized my mind was wandering and I was no longer focused on my breathing, I recognized that mind wandering will happen and simply returned my attention to my breathing.

   Not true at all – 1 2 3 4 5 6 7 8 – Completely true

   3b. When I realized my mind was wandering, I was irritated with myself for becoming distracted and not being able to focus on my breathing as the recording instructed.

   Not true at all – 1 2 3 4 5 6 7 8 – Completely true

3. Had you heard of mindfulness or practiced it in the past prior to completing the exercise? If so, please briefly describe your prior exposure to mindfulness:

_____

_____

Instructions: Please answer the following questions about the **second color-naming task**. Again, your answers will not affect your credits for the experiment, nor will they be seen by anyone other than the experimenter. It is important that you answer as honestly as possible.

1. Did the competition impact your color naming ability? If so, how?

_____

2. Did receiving the noise blasts impact your color naming ability? If so, how?

_____

3. How much anxiety/distress did you feel during the competition?

None at all – 1 2 3 4 5 6 7 8 – Very much

4. How angry did you feel during the competition?

Not at all – 1 2 3 4 5 6 7 8 – Very much

5. What do you believe was the sex of your opponent?

Male Female Don't Know

6. How confident were you that you were competing against a "real" opponent?

Not at all – 1 2 3 4 5 6 7 8 – Very much

7. Did you know anything about this experiment before you participated? If so, please describe what you knew.

_____

ADDITIONAL COMMENTS? *Please provide below*.

_____

APPENDIX D

INFORMED CONSENT

Informed Consent

I agree to participate in the research project titled "State of Mind Effects on Reaction Time" being conducted by Kristen Thompson, MA, a graduate student in the clinical psychology program at Northern Illinois University (NIU), under the supervision of Alan Rosenbaum, Ph.D., a faculty member of NIU's psychology department. I have been informed that the purpose of this study is to gather information about the effects of state of mind on reaction time.

I understand that I will be asked to complete two short tasks and then I will be asked to relax while listening to an audio recording. I will then be asked to participate in a competitive reaction-time task against an opponent, whose identity will not be revealed to me. I understand that the reaction-time task will involve a series of reaction time trials in which noise blasts will be received by the losing player. Before each trial of the game, I will select a noise blast for my opponent, and my opponent will select a noise blast for me. Upon the completion of each game trial, the losing player will receive the noise blast chosen by the winning player. Finally, I will be asked to complete a series of short surveys. I understand that participation in this study is estimated to take about 1 hour.

I am aware that my participation is voluntary and that I may withdraw at any time without penalty or prejudice. If I have any additional questions concerning this study, I may contact Dr. Rosenbaum at (815) 753-9306. If I would like further information regarding my rights as a research participant, I may contact the NIU Office of Research Compliance at (815) 753-8588.

I understand that the intended benefits of this study include the ability to contribute to research and to gain exposure to the research process. I understand that I will also benefit from participating in this study by receiving course credit, which is one way of completing the research requirement for Psychology 102 at NIU.

I have been informed that the potential risks/discomforts I could experience during this study are minimal and include possible discomfort associated with the noise blasts. The maximum noise blast that either my opponent or I could receive is 100 decibels, which is the equivalent of a large orchestra. I understand that all information gathered during this experiment will be kept anonymous by the separation of this consent form from the rest of my questionnaire materials. I also understand that all data collected will be kept in files in a locked cabinet and on a computer inside a locked laboratory.

I understand that Northern Illinois University policy does not provide for compensation for, nor does the University carry insurance to cover physical injury or illness suffered as a result of participation in University sponsored research projects.

I understand that my informed consent to participate in this project does not constitute a waiver of any legal rights, and I acknowledge that I have received a copy of this consent form.

_____

Signature of Subject Date

_____

Signature of Witness Date

APPENDIX E

FOCUSED BREATHING TRANSCRIPT

Focused Breathing Transcript

In a few moments, 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 judgment. It is about knowing exactly what we are doing, as we are doing it. 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 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. I am going to ask you to direct this kind of attention to your breath and your experience of breathing. I will walk you through, step by step, what you need to do to cultivate this kind of attention.

Come now to a comfortable sitting position in your chair with your spine erect but not strained, maintaining a thought of your spine and your torso coming up out of the hip joints all the way through your neck and your head, and your head, being light and floating gently at the top of your spine. You may wish to close your eyes or lower your eyelids. Take a moment now to locate the place in your body where you can feel your own breathing the most clearly and the most easily. This might be in your nostrils, where you notice the air passing in and out or perhaps your chest that rises and falls slightly with your inhalation and your exhalation. Or maybe your belly, your lower abdomen, where there are slight movements with the rhythm of your breathing. Wherever it may be, bringing your attention now to this place and noticing your in-breath and out-breath.

Do not try to change your breathing in any way, or to manipulate your breathing, or control your breathing. Rather, just observe your own breathing. Befriending your breath, bringing your awareness right up close to your breath and following the in-breath from its beginning to its end and following the out-breath from beginning to end. Bringing your full attention to your breathing, knowing that your breath is an anchor to the present moment, a way for you to be in touch with your experience in the present moment by moment. Noticing the in-breath and the out-breath, as one follows the next. Following the in-breath for the entire length of its duration. Perhaps even noticing a slight pause at the end of the exhalation, just before your body starts to breathe in its next breath. And staying in touch, in this way, breath by breath, moment by moment.

You may notice from time to time that your mind is wandering, that you are no longer with your breathing, but that your mind is lost in thought. Understand when this happens that it is the nature of the mind to wander. It's the habit of the mind to look for distractions. And without criticizing yourself or your mind, without judgment, when you notice that your mind is wandering, simply note – it's the wandering mind – and then gently and with great care, invite your mind to return to your next breath. Bringing your awareness and your full attention to the next breath, and continuing to follow your breathing. Each time that you notice that your mind is wandering, there is no need to get caught up in the content of the thoughts, in the plot or the story line. Simply notice that you are thinking, that you are no longer with your breath, and very gently escort your awareness and your full attention back to your breathing.

Let go of any thoughts of how long you have been sitting here or how many minutes might be left in this sitting. Just simply stay with your breathing, approaching the next breath with fresh interest and new awareness, as if it were the first breath of this sitting. Each in-breath truly a new beginning, each out-breath another opportunity to let go of what is already over. And following your in-breath and your out-breath, one breath after the next, from moment to moment. In a few moments, I will ask you to stop and we will continue with the rest of the study. Please begin to return your attention to the room. When you are ready, open your eyes. Please open the door and alert the experimenter that you are finished and prepared to proceed.