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Mindful Attention Training for Compulsive Urges: An Experimental Investigation

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UNIVERSITY OF MIAMI

MINDFUL ATTENTION TRAINING FOR COMPULSIVE URGES: AN
EXPERIMENTAL INVESTIGATION

By

Demet Çek

A DISSERTATION

Submitted to the Faculty
of the University of Miami
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A dissertation submitted in partial fulfillment of
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MINDFUL ATTENTION TRAINING FOR COMPULSIVE URGES: AN
EXPERIMENTAL INVESTIGATION

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Introduction. Mindful attention (MA) training is a brief computerized intervention that instructs participants to nonjudgmentally observe thoughts and sensations in lieu of reflexively reacting to them. Experimental studies have demonstrated that MA training decreases *appetitive* urges with regards to unhealthy eating and risky sexual behaviors. It remains unclear whether MA would have a similar effect on *aversive* urges, such as compulsive urges arising from intrusive thoughts. The current study investigated the effects of MA training on compulsive urges associated with two obsessive-compulsive symptom (OCS) dimensions, and examined the moderating roles of OCS severity and cognitive flexibility on urge-related clinical indicators. **Method.** Using a 2 (training condition: MA; Control) x 2 (OC stimulus condition: Harm; Contamination) factorial design, we examined the effects of MA training on responses to OCS-provoking tasks in an at-risk sample of young adults ($N= 97$). A picture viewing task and a behavioral task were designed to elicit intrusive thoughts associated with one of two OCS dimensions: either *unacceptable thoughts/neutralizing* or *contamination/cleaning*. Picture viewing task outcomes included perceived aversiveness of task stimuli and compulsive urges; behavioral task outcomes included distress, urge strength, and compulsive behaviors. **Results.** Contrary to hypotheses, MA training did not consistently produce more adaptive responses across the picture viewing or behavioral tasks compared to Control training. However, participants in the Harm condition reported lower distress,

urge strength, and compulsive behaviors on the behavioral tasks compared to those in the Contamination condition. Specifically, the MA/Harm group reported significantly weaker compulsive urges than both the MA/Contamination and Control/Contamination groups, as well as lower distress than the MA/Contamination group. However, these effects did not remain significant after controlling for dysfunctional OC beliefs. For individuals low on OCS severity, MA training led to higher disgust ratings and stronger cleaning urges compared to Control training on the contamination picture viewing task. Cognitive flexibility did not moderate the effect of OCS severity on any of the picture viewing or behavioral task outcomes. **Discussion.** This was the first study to experimentally examine the effects of MA training on compulsive urges. Results did not support the use of MA training over and above a relaxation-based Control training for either OCS dimension. Preliminary evidence supported the efficacy of MA in overriding harm-related urges compared to contamination-related urges. The present findings suggest that MA training works differently for compulsive urges that motivate avoidance behavior than it does for approach-driven appetitive urges. Understanding the interplay between MA, OC beliefs, and OCS dimensions would be a meaningful next step towards increasing the benefits of MA training, either as a tool to increase engagement in OCD exposures or as a stand-alone intervention.

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Chapter 1: Introduction

Obsessive-compulsive disorder (OCD) is characterized by repeated unwanted thoughts, images, or impulses (i.e., obsessions) that elicit anxiety, and result in overt or covert rituals (i.e., compulsions) that are meant to neutralize the discomfort associated with obsessions (APA, 2013). Obsessive-compulsive symptoms (OCS) have been found to lie on a continuum, ranging from mild, normative symptoms to extremely severe clinical cases (Olatunji, Williams, Haslam, Abramowitz, & Tolin, 2008). OCD is the fourth most common psychological disorder after depression, substance abuse, and anxiety disorders (Karno, Golding, Sorenson, & Burnam, 1988). Worldwide prevalence estimates for OCD are approximately 1.5-3% (Okasha, 2002; Ruscio, Stein, Chiu, & Kessler, 2010), though approximately 8.7% of the population endorses subclinical levels of OCS (Angst et al., 2004). The ramifications of struggling with OCD can be so severe, that the World Health Organization has identified OCD as the tenth most disabling medical condition (Murray, Lopez, Mathers, & Stein, 2001). Furthermore, unlike many other psychological disorders, even the milder forms of OCS can negatively impact an individual's daily functioning and quality of life (Fairfax, 2008).

Overview of OCD and Existing Treatments

OCD is a clinically heterogeneous syndrome. Factor analytic studies suggest that OCS are most commonly characterized by five factors that encapsulate both obsessions and accompanying compulsions (Abramowitz et al., 2010; Mataix-Cols, Conceição do Rosario-Campos, & Leckman, 2005; Mataix-Cols, Rauch, Manzo, Jenike, & Baer, 1999), and include the following symptom dimensions. The *contamination/cleaning* symptom dimension is characterized by obsessions related to being contaminated by germs or dirt

and compulsive cleaning and decontaminating rituals. The *unacceptable thoughts/neutralizing* symptom dimension involves intrusive thoughts that are inconsistent with one's belief system and are usually themed around sex, violence, or blasphemy. Unacceptable thoughts may be accompanied by behavioral (e.g., repeating meaningless phrases, tapping rhythms on a table top) and/or mental (e.g., praying to oneself) neutralizing rituals. The *responsibility for harm /checking* symptom dimension includes thoughts about accidentally being responsible for harm, and includes checking compulsions. The *symmetry/ordering* symptom dimension comprises obsessions triggered by disorderliness and symmetry concerns, which are matched with arranging or sorting compulsions. Finally, the *hoarding* symptom dimension reflects intrusive thoughts and beliefs about the potentially adverse consequences of discarding items and is associated with saving unneeded items and distress regarding discarding objects. Individuals with OCD can endorse symptoms across any combination of these five dimensions, which may surface at varying frequencies and intensities. Importantly, each symptom domain has been linked with distinct etiological factors (Mataix-Cols, Rosario-Campos, & Leckman, 2005), including different beliefs (e.g., Brakoulias et al., 2014), neuropsychological deficits (e.g., McGuire et al., 2014), familiarity patterns (e.g., Hasler et al., 2007), and neural correlates (Mataix-Cols et al., 2003; Mataix-Cols et al., 2004).

Cognitive therapy (CT) and exposure and response prevention (ERP), a specific form of cognitive behavioral therapy (CBT), have received strong research support and are deemed evidence-based psychological treatments for OCD (APA, 2013). The first line treatment for OCD consists of ERP and may or may not include pharmacotherapy depending on symptom severity (NICE, 2006). Although existing treatments alleviate the

OCD symptoms of many, up to 41% of those who receive ERP do not become symptom-free at post-treatment (Whittal, Thordarson, & McLean, 2005), and 40-60% of treated patients do not respond to the gold standard pharmacological treatment with clomipramine and selective serotonin reuptake inhibitors (Mataix-Cols, Conceição do Rosario-Campos, et al., 2005).

Two primary reasons have been proposed to account for treatment non-response. First and foremost, the acceptability of ERP and pharmacotherapy may be lower than anticipated. The primary mechanism of ERP is exposing patients to the triggers of their obsessions (e.g., a dirty toilet), which typically elicits a fearful response and an accompanying urge to conduct a neutralizing behavior (e.g., hand washing) that would alleviate anxiety in the short-term (Foa & Kozak, 1986). However, within the context of ERP, patients are instructed to prevent or inhibit their behavioral response so that they may habituate to the stressful stimuli, while simultaneously testing the accuracy of their beliefs regarding the probability that harm will ensue. The aim of this technique is for the affected person to collect evidence that disconfirms fear-driven beliefs and to replace distorted beliefs with more realistic ones. Though exposures with practice can be highly effective in reducing distress associated with obsessional triggers, patients (unsurprisingly) find them aversive. It has been theorized that this stress-inducing aspect of exposures partially explains why 30% of patients either refuse treatment, drop out of therapy (Maltby & Tolin, 2005), or do not practice exposures between sessions as prescribed (Simpson, Franklin, Cheng, Foa, & Liebowitz, 2005).

Difficulties regarding acceptability also exist with respect to pharmacotherapy. Many individuals hold unfavorable attitudes towards psychotropic medications, which

discourage them from selecting this form of treatment (Hegerl, Althaus, & Stefanek, 2003). Other patients find the side effects (e.g., increased heartbeat, weight gain, diarrhea, breathing problems, hair loss, and memory problems) too unpleasant to continue medication use (Williams, Davis, Powers, & Weissflog, 2014). Moreover, even for patients who pursue pharmacotherapy, medication discontinuation is associated with the return of clinically significant symptoms (Fineberg, Reghunandan, Brown, & Pampaloni, 2013).

An additional consideration regarding treatment response rates for OCD is that the existing empirically validated treatments are not always equally efficacious across the different manifestations of OCD (Christensen, Hadzi-Pavlovic, Andrews, & Mattick, 1987; Mataix-Cols, Marks, Greist, Kobak, & Baer, 2002; Mataix-Cols et al., 1999). For example, the unacceptable thoughts symptom dimension is more challenging to treat with ERP than other symptoms (Clark, 1999; Freeston & Ladouceur, 1997; Mataix-Cols et al., 2002; Williams, Farris, et al., 2014). It has been proposed that implementing ERP for unacceptable thoughts may be more challenging because the rituals tend to be primarily mental, and reassurance seeking is frequently overlooked as a compulsion (Williams et al., 2011). Another explanation for the noted treatment differences is that etiological factors have also been found to differ across the dimensions. Particularly relevant for CBT and ERP is the finding that although the overarching diagnosis of OCD is characterized by biased cognitions and beliefs, each symptom dimension has been linked with distinct obsessive beliefs (Wheaton, Abramowitz, Berman, Riemann, & Hale, 2010). For instance, the contamination symptom dimension is most strongly linked to beliefs related to responsibility and threat estimation (Wheaton et al., 2010), whereas

unacceptable thoughts/neutralizing symptoms are associated with greater belief in the importance and control of thoughts (Brakoulias et al., 2014; Wheaton et al., 2010). In addition, unacceptable thoughts have been associated with significantly more guilt compared to other symptom dimensions (Lee & Kwon, 2003), and are more challenging for patients to share in treatment (Rachman, 2007). Identifying alternative treatment strategies that directly address the specific OC belief associated most strongly with the target OC symptom dimension, and using these strategies to support evidence-based treatments such as ERP may increase treatment adherence and the acceptability of exposures.

Mindfulness-based interventions have been highlighted as a potentially effective treatment for affective disorders (Hoffman, Sawyer, Witt, & Oh, 2010). Recent research supports the notion that components of acceptance and mindfulness-based approaches may provide novel ways to present the rationale of exposures to OCD patients and facilitate clients' tolerance of intrusive thoughts during exposures (Strauss, Cavanagh, Oliver, & Pettman, 2014; Twohig et al., 2015). Skills taught in these treatment modalities, such as accepting the impermanence of thoughts and separating the content of thoughts from self, may reduce the salience of intrusive thoughts, subsequently decreasing urges to complete neutralizing rituals. Preliminary evidence suggests that mindfulness-based interventions are effective in decreasing OCD symptoms (Hanstede, Gidron, & Nyklicek, 2008; Hertenstein et al., 2012; Patel, Carmody, & Simpson, 2007; Singh, Wahler, Winton, & Adkins, 2004; Wilkinson-Tough, Bocci, Thorne, & Herlihy, 2010). However, it remains unknown which mindfulness techniques are responsible for

symptom reduction, whether mindfulness skills are equally efficacious for different types of OCS, and which cognitive factors influence the effectiveness of these techniques.

The current study examined the effects of a brief mindful attention (MA) training on compulsive urges and behavioral rituals. The training was designed to teach individuals to perceive their thoughts as *mental events in the field of awareness, rather than facts requiring immediate action*. The overarching aim of the investigation was to identify whether MA training modulated the influence of OCD relevant triggers on compulsive urges.

Defining Mindfulness and Mindfulness-Based Interventions

The term *mindfulness* originated in Buddhist principles and philosophy. Since its adaptation for use in Western psychology, it has been defined in many different ways, across a broad range of contexts. Although there is no consensus on how best to characterize it, one of the most frequently cited definitions of mindfulness is that it is “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment” (Kabat-Zinn, 2003). In an early effort to operationally define mindfulness, Bishop and colleagues (2004) proposed a two-component model derived from Kabat-Zinn’s description. The first component of the model is self-regulation of attention, and involves maintaining attention on the immediate experience. The second element involves welcoming all present moment experiences with curiosity, openness, and acceptance. Thus, initial models of mindfulness emphasize the purposeful and intentional use of attention along with a genuinely open and accepting attitude.

Lutz, Jha, Dunne, and Saron (2015) expanded upon previous definitions of mindfulness and proposed a neurocognitive framework for mindfulness-related practices. This more contemporary view posits that *object orientation*, *dereification*, and *meta-awareness* are defining features of mindfulness included in all types of mindfulness training and that they can be expressed independent of one another. Object orientation refers to the orienting and maintenance of attention on a particular object or internal state. This feature emphasizes a state wherein attentional resources are oriented toward an internal or external target even if target selection has yet to take place. Dereification is the perception that internal experiences are mental events rather than true reflections of reality. Meta-awareness involves monitoring the contents of one's experience. Broadly, mindfulness training is thought to lead to a way of relating to internal and external experiences using a nonreactive stance towards subjective experience, a moment-to-moment awareness of the contents of consciousness, and intentional attention.

Attention and emotion regulation deficits are two important vulnerability factors that cut across many forms of psychopathology (Harvey, Mansell, & Shafran, 2004), accordingly, mindfulness-based interventions (MBIs) have been developed to target these two processes (Tang, Holzel, & Posner, 2015). MBIs have become increasingly popular in the last three decades (Bishop, 2002; Kabat-Zinn, 1994), and include mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982) and mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002). Both of these are 8-week group therapy interventions designed to teach mindfulness skills, such as deep breathing, body scanning, and sitting meditation (Kabat-Zinn, 2003). Third wave cognitive therapies (Hayes, 2004) such as Acceptance and Commitment Therapy (ACT; Hayes & Wilson,

2004) and Dialectical Behavior Therapy (DBT; Linehan, 1993) also include mindfulness components, but differ from each other and from MBSR and MBCT in the frequency and duration of mindfulness practice involved and their use of non-mindfulness therapeutic elements (Gu, Strauss, Bond, & Cavanagh, 2015). Mindfulness skills have also been incorporated into substance use interventions, resulting in the development of mindfulness-based relapse prevention (Witkiewitz, Marlatt, & Walker, 2005). Robust findings from randomized clinical trials of these interventions have demonstrated the effectiveness of MBIs compared to control conditions for reducing anxiety (Green & Bieling, 2012; Hoffman et al., 2010), depressive symptoms (Strauss et al., 2014), risk of relapse for depression (Kuyken et al., 2008; Teasdale et al., 2000), and stress (Chiesa & Serretti, 2009). MBIs have yielded large post treatment effect sizes of .97 (Hedge's g) in the treatment of anxiety disorders, effects that were maintained at a median follow-up period of 3 months (Hoffman et al., 2010).

Mindfulness skills are thought to improve psychological well-being in a number of ways. First, from a theoretical perspective, it is hypothesized that participating in one's immediate experience with full attention and an open, accepting attitude counters ruminative thinking about the past and worrying about the future, both of which contribute to the development of negative affect and maintenance of depression and anxiety symptoms (Ehring & Watkins, 2008). It is argued that developing an awareness of thoughts as transient mental events contributes to recognizing the redundancy of reacting to each distressing thought, and decreases rumination (Bishop et al., 2004). Second, mindfulness is hypothesized to reduce heightened emotional reactivity that characterizes many psychological disorders (van der Velden et al., 2015), by teaching

more reflective, as opposed to reflexive or automatic, ways of responding to stress (Bishop et al., 2004). In a systematic meta-analysis of 20 studies that examined the active ingredients of MBIs on psychological outcomes, Gu et al. (2015) found strong evidence to suggest that reductions in cognitive and emotional reactivity drive changes in MBIs. It may be that MBIs foster a sense of acceptance and nonreactivity to one's experience, which leads to a reduction in symptoms. Some evidence was found for the mediating roles of mindfulness, rumination, and worry, suggesting that MBIs help individuals by increasing mindfulness skills and decreasing repetitive negative thinking patterns. A third hypothesis is that the slow and deep breathing incorporated in mindfulness practice may help balance sympathetic and parasympathetic systems (Brown & Gerbarg, 2005). Affective disorders are characterized by an imbalance of these systems, and physiological equilibrium is associated with more adaptive stress responding (Kabat-Zinn, 2003).

Mindfulness-Based Interventions for OCD

Several of the reasons for why ERP may be less efficacious for some individuals with OCD, are precisely the reasons why MBIs could be helpful for this condition. First, teaching individuals to relate to their thoughts as they are without attempting to change them could increase willingness to participate in exposures. There is data to suggest that combining ERP with ACT, a form of CBT that includes mindfulness skills within a values-based therapeutic framework, could provide a novel method of framing exposures and increasing patients' willingness to openly accept (as opposed to tolerate) discomfort that arises in response to obsessions (Twohig et al., 2015). Although extant evidence does not support the use of ACT over ERP for OCD (Bluett, Homan, Morrison, Levin, & Twohig, 2014), experimental evidence suggests that acceptance-based strategies decrease

distress over the course of exposure (Marcks & Woods, 2005), and may be utilized to increase treatment participation among exposure-resistant clients (Twohig et al., 2015).

Second, as stated above, OCD symptom dimensions are associated with distinct cognitions and belief sets, some of which may be particularly amenable to change via mindfulness skills. For example, unacceptable thoughts, such as harming self or vulnerable others, are typically experienced as highly ego-dystonic and are associated with extreme distress given the inconsistency between the nature of the repugnant thoughts and one's values. Individuals with OCD believe that they may act on such thoughts, feel ashamed as a result, and deduce that they should control their thoughts (Lee & Kwon, 2003). Learning a skill that may counter such maladaptive cognitions regarding the importance and control of thoughts may help reduce the need to neutralize. MA includes perceiving thoughts as transient mental events that are not connected to one's identity in any meaningful way and is therefore a potentially useful tool against distressing intrusive thoughts and images.

Despite the wealth of knowledge on the effectiveness of MBIs for anxiety and mood disorders, only a handful of studies to date have investigated the efficacy of MBIs for OCD (Hanstede et al., 2008; Hertenstein et al., 2012; Patel et al., 2007; Singh et al., 2004; Wilkinson-Tough et al., 2010). Wilkinson-Tough and colleagues (2010) used a case-series design where participants completed a 2-week no-intervention monitoring phase, followed by a 2-week relaxation phase as an active control intervention, and 6 sessions of mindfulness-based individual therapy. The latter included mindfulness and acceptance exercises drawn from DBT (Linehan, 1993), and psychoeducation on OCD. The researchers found a significant decrease in OCS from pre- to post-treatment, which

was maintained at a 2-month follow-up for two of the three participants. Additionally, a comparison of the relaxation (weeks 3-4) and mindfulness (weeks 5-10) phases showed significant differences in the levels of thought suppression, thought action fusion (TAF; i.e., the belief that thoughts are akin to behavioral actions), and distress, favoring the mindfulness period. In another study, Hanstede and colleagues (2008) demonstrated that an 8-week mindfulness intervention decreased TAF and OCS in a sample of students who endorsed at least one OCS, compared to a waitlist control group. Increases in the ability to detach from intrusive thoughts mediated the effects of the intervention on OCS.

Based on these initial findings, Külz and colleagues (2014) adapted Segal, Williams, and Teasdale's (2002) 8-week MBCT for depression program to OCD and conducted a pilot study with individuals who had residual OCS following cognitive behavioral treatment. The researchers found significant decreases in Yale-Brown Obsessive-Compulsive Scale (YBOCS; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) scores from baseline to post-intervention, which were maintained at a 6-month follow-up. Effects sizes were reported to be within the medium range. Encouraged by these preliminary findings, Külz and colleagues (2014) designed a randomized controlled trial (RCT), which is currently in progress. Patients with a primary diagnosis of OCD who had no or partial response to CBT ($N= 128$) are randomly assigned to either an 8-week MBCT group or a psychoeducational program for OCD. Both interventions are delivered in weekly 120-minute group sessions. Külz and her research team hypothesized that they will find greater reductions in OCS and depressive symptoms in the MBCT group at post-intervention and follow-up assessments than in the psychoeducational group. The researchers are also examining changes in quality of life,

metacognitive beliefs, self-compassion, mindful awareness, and approach-avoidance tendencies in this RCT. This study is the first to systematically examine the efficacy of MBCT for OCD and will be instrumental in providing an initial understanding of the potential of MBCT for CBT non-responders.

Another interesting effort in this area is a pilot RCT that synthesizes MBCT and ERP (Strauss et al., 2015). In this ongoing investigation, a clinical sample of individuals with OCD ($N= 40$) are randomized to 10 sessions of ERP or mindfulness-based ERP (MB-ERP). In addition to modules on traditional ERP, the MB-ERP groups are introduced to the rationale of incorporating mindfulness skills into therapy, practice mindfulness exercises within and in between sessions, and are encouraged to incorporate mindfulness skills in their perception of and response to intrusive thoughts. Strauss and colleagues (2015) hypothesize that the MB-ERP group will experience greater decreases in OCS and demonstrate better therapy engagement. They will also examine changes in depressive symptoms, wellbeing, and OCD beliefs. This study is the first to directly compare ERP with MB-ERP for OCD and will reveal whether there are benefits to incorporating mindfulness to ERP. Taken together, these two in progress RCTs (Külz et al., 2014; Strauss et al., 2015), and the studies that provided support for the development of these RCTs (e.g., Hanstede et al., 2008; Wilkinson-Tough et al., 2010), speak to a growing perception that mindfulness offers important and novel contributions to OCD interventions.

Although an accumulating body of evidence suggests that MBIs increase psychological well-being, it is not yet well understood which specific mindfulness skills are key for reducing clinical symptoms (Gu et al., 2015). This is particularly the case for

OCD, where treatments to date (a) have included multiple MBI components, and (b) have targeted any and all OCD symptom dimensions. These studies are therefore unable to clarify whether specific OCS might respond more or less well to specific mindfulness skills. Given that each OCD symptom dimension is characterized by different OCD beliefs and cognitions (Wheaton et al., 2010), it is possible that certain mindfulness skills will match particular maladaptive OCD cognitions more effectively than others.

Specifically, MA, which encourages accepting all experiences regardless of their valence and viewing thoughts as fleeting mental events, may challenge beliefs regarding the importance of thoughts and the need to control them (Didonna, 2009). It may therefore help individuals remain in contact with unacceptable thoughts in spite of the urge to avoid. Additionally, related cognitive factors may affect the mindfulness-OCS relationship and have not been examined in previous studies. The ability to adapt newly acquired mindfulness skills may be influenced by differences in individuals' willingness and ability to disengage from previously used mental strategies. None of the investigations examining MBIs for OCD reviewed above explored specific mindfulness components or cognitive factors that could influence the effectiveness of MBIs for OCS.

One approach to overcoming the shortcomings described above is to use experimental designs to test specific components of MBIs which may help optimize therapeutic effects, distinguish between specific and non-specific (e.g., therapeutic relationship) treatment effects, and identify moderators to match therapies to individuals. Ultimately, understanding mechanisms of interventions inform theory development and interpretation of results (Kazdin, 2007). Therefore, experimentally testing the effects of a single mindfulness component on OCS and examining factors that may influence the

relationship between mindfulness and psychological outcomes would help fine tune existing interventions by enhancing active components, and provide an empirically supported framework to enhance the theory and empirical findings on the effects of MBIs.

Experimental Studies of Mindful Attention

As reviewed above, MA is a core component of more extensive mindfulness interventions, and emerging research suggests that MA could help modulate urges and accompanying behaviors. A brief computerized training was recently developed by Papies, Barsalou, and Custers (2012), and was used to experimentally examine the effects of MA on appetitive urges (Papies, Pronk, Keesman, & Barsalou, 2015). This intervention, called MA training, is largely based on the *attitude* component of Bishop and colleagues' two-component model of mindfulness (2004), which dictates a curious, open, and accepting orientation towards all experience, regardless of its valence. Papies and colleagues (2012; 2015) defined *MA* as a mental state characterized by the awareness that one's experiences, including the most penetrating emotions, thoughts, and urges are only mental events that occur naturally and dissolve ultimately.¹ This perspective cultivates an awareness that cognitions do not signify an accurate and permanent depiction of reality or the self (Didonna, 2009), and implies that urges, desirable or not, will decrease in intensity and disappear regardless of whether one reacts to them.

Applying this definition of MA to our understanding of OCD, accepting the presence of

¹ *Mindful attention*, as defined by Papies and colleagues, (2012; 2015) has also been called *decentering*, *reperceiving*, and *cognitive insight* in the literature (Bishop et al., 2004; Chambers, Gullone, & Allen, 2009; Shapiro, Carlson, Astin, & Freedman, 2006). It also maps onto the dereification component of Lutz, Jha, Dunne, and Saron's (2015) contemporary definition of mindfulness. Because the current study replicates and expands upon the experimental methods employed by Papies and colleagues, the term *mindful attention* will be used in this document.

an urge without immediately and habitually responding to it becomes an option.

Furthermore, the powerful awareness that emerges from this understanding may help decrease maladaptive behavioral tendencies.

In a series of experiments, Papies and colleagues (2012) randomized healthy university students to either a MA or a control training condition. Individuals in the MA training group viewed images of urge-eliciting stimuli (e.g., tasty foods) and neutral stimuli (e.g., neutral foods) and were instructed to consider their responses to the images (i.e., their thoughts and emotions) as transient mental events. More specifically, they were asked to practice MA when viewing each of the pictures. The control group similarly viewed a series of images; however, they were told to “completely immerse” themselves in the pictures. Subsequently, both groups completed a standard approach-avoidance task. Results showed that control participants had an approach bias towards the urge-eliciting stimuli, while those in the MA group did not. This effect was maintained over a 5-minute distraction period, and the overall findings were replicated using a control group that was instructed to “just look at the pictures,” rather than immersing themselves in the images.

Papies and colleagues (2015) extended these findings through additional experiments that examined real-world behaviors, rather than the laboratory based approach-avoidance task. They theorized that vividly imagining the pleasurable consequences of approaching an appetitive stimulus influences the likelihood of pursuing it. The researchers also examined whether state (e.g., hunger) or trait (sexual openness) motivations may influence the effect of appetitive urges on and actual behaviors. Results from one experiment demonstrated that MA training reduced the effect of the

motivational *state* of hunger on unhealthy food choices at a university dining hall, compared to the control condition. Hunger did not influence unhealthy food choices in the MA group, such that individuals who were low and high on hunger were equally likely to choose unhealthy foods. In contrast, in the control condition, hungry participants disproportionately chose more unhealthy foods.

In a separate experiment examining the effect of *trait* motivation on appetitive urges and behavior, MA training decreased the attractiveness and desirability of opposite sex partners in a sample of participants with liberal attitudes towards casual sex. Consistent with the theoretical literature on mindfulness (Chambers et al., 2009; Moore & Malinowski, 2009), Papies and colleagues (2012) concluded that the *attitude* component of mindfulness—that is, learning to view thoughts and emotions nonjudgmentally as transient mental events—prevents impulsive responses to appetitive urges within the context of unhealthy eating and risky sexual behaviors. Their findings were the first to demonstrate that MA reduces the link between motivation (e.g., hunger) and behavior (e.g., choosing unhealthy foods).

Importantly, the studies described above investigated *appetitive* urges (e.g., food, sexual desire), which often surface upon contact with an attractive stimulus, are driven by an expectancy of subsequent positive affect, and results in approach behaviors (Baker, Morse, & Sherman, 1986). That is, when individuals imagine the positive feeling to be experienced upon tasting a tempting food item, the urge to eat it increases substantially. Of note, one's underlying motivational state (e.g., hunger) influences the strength of an appetitive urge (e.g., to eat). In contrast, compulsive urges that characterize OCD are *aversive* and tend to be driven by a desire to reduce negative affect, along with escape

behaviors. An example of this kind of aversive urge is when an individual with OCD feels the need to leave a bathroom perceived to be contaminated.

Though the function underlying the two types of urges is different (i.e., appetitive urges to achieve positive affect in response to appetitive stimuli vs escape urges to reduce negative affect in response to aversive stimuli), they have a number of qualities in common. First, both urges drive a reflexive behavioral response that may feel more or less controllable depending on the strength of the underlying motivation. Second, while in large part these urges and accompanying behaviors do not cause any significant problem, at times the inability to inhibit the behavior can be contraindicated for an individual's long-term well-being. For example, the inability to inhibit the urge to gamble (an appetitive urge), may result in a lost bet, which could in turn lead to long-term financial difficulties. Similarly, while it is natural to feel the urge to wash one's hands after touching a dirty bathroom door handle (an aversive urge), for the individual with OCD these urges become so strong that they resort to extensive washing rituals that may take hours at a time. The direct link between urge and behavior makes aversive urges valuable targets for OCD interventions and are addressed in ERP (Foa & Kozak, 1986). What remains unclear, however, is whether MA could reduce compulsive urges.

MA aims to promote awareness and acceptance of unpleasant thoughts, sensations, and emotions that remove their connection to the self. This detached and nonjudgmental stance is particularly relevant for individuals who believe that intrusive thoughts are inherently connected to their identity (e.g., "Having nasty thoughts means I am a terrible person" OCCWG, 2003) and therefore should be controlled and neutralized with compulsive rituals. MA may counter such dysfunctional beliefs and reduce the

motivation to neutralize. It is possible that OCS severity indicates the baseline motivation underlying the anticipated relief following compulsions. Consistent with findings supporting the link between greater motivation and stronger urges (Papies et al., 2015), greater OCS severity may lead to stronger aversive urges to complete ritualized behaviors.

Although the impact of MA on reducing aversive urges has not been directly examined in the context of mindfulness and OCS, the addiction literature provides support to the benefits of MA for urges that are not purely appetitive. In substance use disorders, continued use is often prompted by a desire to increase positive affect *and* escape the negative sensations of craving (Robinson & Berridge, 2003). Therefore, the urge to use a substance is both appetitive and aversive. Similar to appetitive urges preceding unhealthy food choices (Papies et al., 2015), in the context of substances, maladaptive responses to appetitive/aversive urges mediate use (Marlatt, 1978; Shadel et al., 2011). Marlatt and colleagues (2002; Witkiewitz et al., 2005) have married relapse prevention, a well-established psychosocial treatment for addictions (Epstein, Hawkins, Covi, Umbricht, & Preston, 2003), with mindfulness-based techniques to develop Mindfulness-Based Relapse Prevention (MBRP). MBRP teaches patients to develop an awareness and acceptance of thoughts, sensations, and urges without compulsively acting on them (Marlatt, 2002; Witkiewitz et al., 2005). Research findings support the efficacy of MBRP in decreasing craving (Witkiewitz, Bowen, Douglas, & Hsu, 2013) and relapse rates among individuals with alcohol and substance use disorders (Bowen et al., 2014). Preliminary findings from MBRP trials support that mindfulness weakens the link between the appetitive/aversive urge to use and actual using behavior (Witkiewitz et al.,

2013). Thus, modifying one's relationship both appetitive and aversive urges is key in reducing behaviors that have harmful long-term consequences. It remains unclear whether MA training would be helpful in reducing aversive urges that occur in OCD.

Cognitive Flexibility, Mindful Attention, and OCD

MA is a malleable skill that tends to improve with practice; however, it is possible that there are individual difference variables, such as executive functions, which may influence one's ability to learn and/or apply MA. Identifying cognitive factors that affect the outcomes of MA training may provide valuable information for matching individuals to treatment strategies that they are most likely to benefit from. Studies have examined links between mindfulness training and various facets of executive functioning. Working memory (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010) and sustained attention (see Chiesa, Calati, & Serretti, 2011 for a review; Jha, Krompinger, & Baime, 2007) were found to improve upon completing comprehensive mindfulness programs. However, of the executive functions that have been linked with mindfulness, one that is particularly relevant for the current study and our focus on MA is cognitive flexibility.

Cognitive flexibility refers to the readiness to shift cognition and behavior to adapt to changing environmental demands (Monsell, 2003; Scott, 1962), and may impact the ability to alter one's relationship to intrusive thoughts and images from a reactive stance to a nonreactive one (Didonna, 2009). Cognitive *inflexibility* has been defined as difficulties with inhibiting previously relevant information and changing decision-making in response to feedback from the environment (Lezak, Howieson, Bigler, & Tranel, 2012). OCD has been linked with deficits in cognitive inflexibility and the resulting perseveration in reasoning and behavior (Cavedini, Zorzi, Piccinni, Cavallini, & Bellodi,

2010). Individuals with OCD and their unaffected relatives performed more poorly on tests of cognitive flexibility than healthy controls and their respective relatives (Cavedini et al., 2010). In a sample of young adults, cognitive flexibility differentiated individuals with and without nonclinical OCS (Francasio & Flessner, 2015). Additionally, OCD patients and healthy controls have greater effect sizes for cognitive flexibility (i.e., medium effect), compared to other executive functions that have been linked with mindfulness, such as working memory (Abramovitch, Abramowitz, & Mittelman, 2013).

Cognitive flexibility is also particularly relevant for the investigation of MA training. In contrast to automatic ways of responding, mindfulness cultivates an understanding that in each difficult situation the person has an alternative choice: nonjudgmentally observing challenging thoughts without acting on them or making an effort to change the present. Therefore, it seems intuitive that acquiring the ability to see alternatives when experiencing an urge requires flexibility of thinking (i.e., cognitive flexibility). Empirical evidence suggests that the executive function that may be employed in *earlier* stages of mindfulness training is the ability to distance the self from the content of one's thoughts (Holzel et al., 2011), which is precisely what the MA training is designed to achieve. The shift from a reactive mental stance to a receptive one requires preexisting cognitive flexibility, lending further support to examine this construct as a moderator of a brief training for individuals with limited mindfulness experience.

Current Study Aims and Hypotheses

The literature reviewed above demonstrates that MA is a potentially powerful tool that may be used to reduce the influence of intrusive thoughts on compulsive urges. Very

few published studies to date reported on effects of mindfulness on compulsive urges and none tested the immediate effects of a single mindfulness component (i.e., MA) on the aversiveness of OC stimuli, compulsive urges and behavior. If MA reduces the strength of compulsive urges, it could be used to enhance participant willingness to participate in exposures during ERP and/or open up a new avenue for treatment development. Further, identifying symptom-related (e.g., OCS severity) and cognitive factors (e.g., cognitive flexibility) that may render an individual more or less responsive to MA training, could potentially allow for matching specific treatments with patients.

The aim of this study was to investigate whether, compared to a relaxation-based control condition, MA training reduced the strength of aversive urges elicited by specific OCD-relevant stimuli, and decreased the frequency of compulsive behaviors.

Importantly, we considered two separate OCS dimensions, namely contamination/cleaning and harm-related unacceptable thoughts/neutralizing. We selected to focus on these two symptom dimensions for a number of reasons. The contamination/cleaning symptoms are the most commonly experienced OCS (Rachman & Hodgson, 1980), while unacceptable thoughts are of the most treatment resistant (Alonso et al., 2001). In addition, the qualitative differences between contamination concerns and unacceptable thoughts (Lee & Kwon, 2003), raise the possibility that MA may reduce compulsive urges and behavior associated across these two symptom dimensions in distinct ways. Given that observing thoughts nonjudgmentally as mental events requires a shift in mental perspective, a shift that would be facilitated by non-rigid thinking, cognitive flexibility was explored as a potential moderator of the relationship between MA and compulsive urges.

A 2 (training condition: MA versus Control) x 2 (OC stimulus condition: Harm versus Contamination) between-subjects factorial design was used. Participants were randomly assigned to one of four conditions: MA training (MA/Harm) and a control condition (Control/Harm) within the context of exposure to harm stimuli, and MA training (MA/Contamination) and a control condition (Control/Contamination) within the context of exposure to contamination stimuli. Training type included teaching participants to either pay MA to stimuli (MA condition), or to passively view stimuli in a relaxed manner (Control condition).

Following the training, participants completed a picture viewing task and a behavioral task that were matched to one of two types of obsessional content. In the picture viewing task, harm pictures depicted tools that could be used to harm self or someone else (e.g., gun) while contamination pictures included objects or places that would provoke feelings of disgust (e.g., dirty toilet). Both types of pictures were intermixed with neutral and both positive and negative filler images. As in the experiments of Papiés and colleagues (2015), the aversiveness of the images (frightening or disgusting) and the presence of urges to neutralize upon viewing the pictures was measured.

We also examined responses to a behavioral task. In the harm behavioral task, participants were asked to think about harm befalling a loved one. In the contamination behavioral task, they came in contact with a toilet that was made to look dirty. The outcome variables of the behavioral tasks were distress in response to the task (fear vs disgust), the strength of urge to neutralize, and compulsive behaviors. Of note, both behavioral tasks were in-vivo, even though the harm task required *writing about* and

imagining a distressing scenario because the thoughts and images themselves are the trigger for neutralizing urges. Therefore, for the unacceptable thoughts symptom dimension, purposefully imagining harm befalling on a loved one is the equivalent of coming in contact with a repulsive stimulus for the contamination symptom dimension.

In addition to examining the effects of the training, we also considered two moderating variables. We first examined whether OCS severity would moderate the effect of training condition on responses to the picture viewing and behavioral tasks. We conceptualized OCS severity as the motivation underlying compulsive urges, similar to *hunger* in the Papies and colleagues' (2015) experiments. We also considered cognitive flexibility as a moderator of OCS severity. We elected to only test this interaction effect within the MA training condition, as this was the only condition that required a mental shift in perspective from usual reactive ways of responding to thoughts. Cognitive flexibility was measured via a computerized task, described in detail in Chapter 3.

The sample for the current study consisted of young adults recruited from the larger University of Miami community. The sample was over-selected for individuals at-risk for OCD, with symptom levels ranging from nonclinical to severe. We selected a young adult, non-treatment seeking sample for two reasons. First, findings from taxometric investigations demonstrate that OCS are distributed dimensionally in the general population (Olatunji et al., 2008). Accordingly, the manifestation of OCS in our sample should not be qualitatively different from symptoms experienced by clinical populations. Second, the onset of OCD occurs between the ages of 18 and 22 (Pinto, Mancebo, Eisen, Pagano, & Rasmussen, 2006), supporting the relevance of studying this syndrome in a young adult sample.

The specific aims of this study were:

Aim 1: To examine the main effect and interactions of training condition and OC stimulus condition on perceived aversiveness and compulsive urges in response to the picture viewing task.

Hypothesis 1.1. Training condition will have a main effect on the outcome variables. Compared to the Control training condition, MA training will lead to decreased aversiveness ratings (primary dependent variable) and compulsive urges (secondary dependent variable) in response to the picture viewing task.

Hypothesis 1.2 (Exploratory). OC stimulus condition will moderate the effect of training condition on the dependent variables with individuals in the MA/Harm condition reporting the lowest levels of aversiveness and compulsive urges compared to all other groups.

Aim 2: To examine the main effect and interactions of training condition and OC stimulus condition on distress, urge strength, and compulsive behaviors in response to behavioral tasks.

Hypothesis 2.1. Training condition will have a main effect on the outcome variables. Compared to the Control training condition, MA training will lead to decreased levels of distress (primary dependent variable), urge strength, and compulsions (secondary dependent variables) following either version of the behavioral task.

Hypothesis 2.2 (Exploratory). OC stimulus condition will moderate the effect of training condition on the dependent variables, with individuals in the MA/Harm condition reporting the lowest levels of distress, the least strong urges to neutralize, and compulsive behaviors compared to all other groups following either version of the behavioral task.

Aim 3: To investigate the interaction of training condition and OCS severity on the outcomes of the picture viewing tasks and behavioral tasks for each separate OC stimulus condition (i.e., harm versus contamination). Due to the distinct treatment response rates and different OC beliefs associated with unacceptable thoughts and contamination concerns, Hypotheses 3.1. and 3.2. will be examined separately within each OC stimulus condition.

Hypothesis 3.1. OCS severity (i.e., underlying motivation) will moderate the effect of training condition on the outcome variables, such that perceived aversiveness (primary dependent variable) and compulsive urges (secondary dependent variable) in response to the picture viewing task will be highest among participants with high OCS in the Control training group in response to the picture viewing task for both OC stimulus conditions (e.g., Harm and Contamination).

Hypothesis 3.2. OCS severity will moderate the effect of training condition on the behavioral task outcomes. Individuals with high OCS in the MA training group are hypothesized to experience the highest levels of distress (primary dependent variable) and urge strength (secondary dependent variable) in response to the behavioral tasks for both OC stimulus conditions (e.g., Harm and Contamination).

Aim 4: To investigate the interactions of cognitive flexibility and OCS severity on outcome variables in response to the picture viewing tasks and behavioral tasks in the MA training group. This aim will be examined with participants assigned to the MA training condition only, as we hypothesize that cognitive flexibility is employed when a shift in mental perspective is required. This applies to the MA training, but not the Control training condition. Of note, the harm and contamination

conditions will be collapsed together because cognitive inflexibility is associated with OCS in general (Abramovitch et al., 2013), rather than with one specific symptom dimension.

Hypothesis 4.1. Cognitive flexibility will moderate the effect of OCS severity on the outcome variables of the picture viewing task, such that perceived aversiveness (primary dependent variable) and compulsive urges (secondary dependent variable) in the MA training group will be highest among participants with low cognitive flexibility and high OCS severity.

Hypothesis 4.2. Cognitive flexibility will moderate the effect of OCS severity on the outcome variables of the behavioral task, such that distress (primary dependent variable), urge strength, and compulsions (secondary dependent variable) in the MA training group will be highest among participants with low cognitive flexibility and high OCS severity.

Chapter 2: Method

Participants

A selected sample of young adults ($N= 97$; 58% female; mean age: 19.16, $SD= 1.46$) who were at-risk for OCD based on elevated OC symptomatology participated in the current study. Participants were University of Miami (UM) students, either from the Introductory Psychology participant pool ($N= 90$) or age-matched, non-Psychology students who responded to flyers that were posted across the UM campus ($N= 7$). Table 1 describes the sociodemographic characteristics of the sample, while Table 2 summarizes the psychiatric symptom profile of participants, including both OCD relevant variables and comorbidity.

Inclusion/Exclusion Criteria. Individuals were asked to report their mindfulness experience and complete a measure assessing OCS to determine study eligibility. The mindfulness experience question read “Have you ever had any experience with mindfulness or meditation?” in multiple choice format. Those who endorsed having ‘extensive’ experience with mindfulness or meditation were not eligible to participate.

The *obsessions* subscale of the Obsessive Compulsive Inventory-Revised (OCIR; Foa et al., 2002), which is the strongest predictor of OCD diagnostic status (Foa et al., 2002), was also completed. Among individuals with minimal or no mindfulness experience, participants who scored 4 or higher on OCIR *obsessions* were invited to participate. Enrollment was monitored to ensure that over 60% of the sample comprised individuals with an *obsessions* score of 4 or higher. This group represented 64% of the final sample. A smaller group with *obsessions* scores lower than 4 (36% of the sample) was also recruited. The aim of this oversampling strategy was to obtain a suitable number

of individuals at risk for developing OCD, while maintaining an adequate distribution of OCS.

Individuals were excluded from the study if they reported non fluency in English, were experiencing current suicidality, or endorsed symptoms of mania or psychosis. In addition, we excluded individuals based on extensive experience with mindfulness (see Post-Randomization Data Exclusions under Results for a detailed explanation).

Procedure

Recruitment and Screening Procedures. Consistent with departmental research recruitment procedures, Introductory Psychology students completed screening measures in the beginning of the academic semester that were used to determine study eligibility. Their counterparts from the UM campus completed these measures when they contacted our laboratory to express interest in the study in response to advertisements. See Figure 1 for a CONSORT flow chart of the current sample.

Overview of Laboratory Session (see Figure 2). Eligible participants were invited to the laboratory for an experimental session that lasted approximately 2 hours. All participants were provided with a link to a website where they would read a brief online consent form and complete the Yale-Brown Obsessive-Compulsive Symptom Checklist (YBOCS-SC; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) prior to the experiment session.

In the laboratory, participants were told that the aim of the investigation was to examine cognitive processes and emotions related to behaviors and individuals' experience of thoughts. Individuals who had not completed the online consent form and the YBOCS-SC at home did so in the beginning of the experiment session. After

providing written informed consent, participants were randomly assigned to one of four experimental conditions: MA/Harm, MA/Contamination, Control/Harm, or Control/Contamination.

The experimenter accompanied participants to a separate room in the laboratory where a doctoral trainee reviewed the YBOCS-SC responses with the participant and administered the YBOCS and MINI Neuropsychiatric Interview (Lecrubier et al., 1997; Sheehan et al., 1997) clinical interviews. Doctoral trainees received a standardized training on the administration and scoring of psychodiagnostic tools and symptom severity rating scales. The training involved completing coursework, watching standardized videos, shadowing senior interviewers, being observed by a senior examiner, and receiving feedback on interview administration and scoring. Interviewers also attended weekly supervision.

Following the clinical interviews, the experimenter provided participants with instructions to complete the cognitive flexibility task (Intra/Extradimensional (IED) Test) on a tablet. After the IED Test, participants completed the training or control task, where they mentally applied MA or Control instructions to images they viewed on the computer screen. They subsequently rated the ease of the training instructions and their perceived success in applying them, and completed a measure assessing mind wandering during the task. Participants then completed the picture viewing task ratings, where they were shown the same images in two separate blocks. In one of the blocks, they reported their urge to neutralize in response to the images. In the other block, they rated the aversiveness of the pictures. The order of the blocks and the images within the blocks were randomized. Finally, participants completed an in-vivo behavioral task determined by their

randomization condition (i.e., Harm or Contamination), and filled out self-report questionnaires on a confidential data collection website. At the end of the experiment session, participants were thanked and debriefed (see Appendix H). Introductory Psychology students were awarded a \$2 bill and research familiarization credits, and individuals recruited from the campus were paid \$20. The instruments are described in detail in Chapter 3: Measures.

Chapter 3: Measures

Self-Report Instruments

Demographic and Mindfulness Experience Questionnaire. Participants were asked to provide basic demographic information including age, sex, race, and psychiatric diagnosis (see Appendix G). They also reported whether they had previous experience with mindfulness or meditation, along with the type and duration of their experience.

Obsessive-Compulsive Inventory-Revised (OCIR; Foa et al., 2002). OCIR is an 18-item measure to assess OCS severity (see Appendix A). The six subscales include washing, obsessing, hoarding, ordering, checking, and neutralizing. Items are rated based on how distressing the particular symptom has been in the past month using a scale that ranges from 0 (*not at all*) to 4 (*extremely*). Total scores range from 0-72, with higher scores being associated with more severe OCS. Past research has found the OCIR to be valid with good psychometric properties (Abramowitz & Deacon, 2006; Foa et al., 2002; Huppert et al., 2007). In this study, the sum of the three items that comprise the *obsessions* subscale was used as a screening instrument to select at-risk participants, as it has been shown to have good sensitivity to differentiate between individuals with OCD and healthy controls (Foa et al., 2002). OCIR demonstrated good internal consistency in our sample ($\alpha = .89$). The obsessions subscale had good internal consistency as well ($\alpha = .85$).

Cognitive Interference Questionnaire (CIQ; Sarason, Sarason, Keefe, Hayes, & Shearin, 1986). CIQ is a 21-item questionnaire that assesses cognitive interference immediately after performing a task (see Appendix F); items ask about the frequency of task-related and task-unrelated thoughts. A Likert-type scale is used for the ratings with

scores ranging from 1 (*never*) to 5 (*very often*). The range of total scores is 16-80, with greater scores indicating more cognitive interference. In the current study we used a slightly modified 16-item version of the CIQ to assess mind wandering during each of the training conditions, in line with previous studies (e.g., Mrazek, Franklin, Phillips, Baird, & Schooler, 2013). The CIQ demonstrated good internal consistency ($\alpha = .83$) in the present sample.

Post-Training Questions (*Lebois et al., 2015; Papiés et al., 2015*). As a manipulation check, participants rated their understanding of the training instructions and their ability to follow them on 9-point Likert-type scales ranging from 1 (*not at all*) to 9 (*very much*). The post-training questions are outlined in Appendix E.

Obsessive Beliefs Questionnaire (OBQ; OCCWG, 2003). OBQ is a 44-item questionnaire that evaluates dysfunctional beliefs and cognitions associated with OCD symptoms. It includes 3 subscales: responsibility/threat estimation, perfectionism/certainty, and importance/control of thoughts. Participants rate the extent to which each item describes their thinking on a 7-point Likert-type scale ranging from 1 (*disagree very much*) to 7 (*agree very much*). OBQ has established good convergent and discriminant validity in both clinical and nonclinical samples (OCCWG, 2005). In our sample, the OBQ demonstrated excellent internal consistency ($\alpha = .96$). Responsibility/threat estimation, perfectionism/certainty, and importance/control of thoughts subscales also had excellent internal consistency (α 's = .91, .94, and .91 respectively). The OBQ total score and subscales were utilized to describe the sample characteristics with respect to OCD beliefs.

Depression, Anxiety, Stress Scales (DASS-21; Henry & Crawford, 2005). The *depression* and *anxiety* subscales (7 items each) were used in the current study.

Participants rate the extent to which they experienced symptoms of depression or physiological anxiety in the past week on a 4-point Likert type scale from 0 (*did not apply to me at all*) to 3 (*applied to me very much*). DASS-21 has established good convergent and discriminant validity (Lovibond & Lovibond, 1995) and adequate construct validity (Henry & Crawford, 2005). The 14 depression and anxiety items exhibited good internal consistency in the current sample ($\alpha = .89$).

Mood Ratings. Participants were asked to rate their affective state (anxiety, sadness, and irritability) on a Likert-type scale from 1 (*not at all*) to 7 (*very much*) before and after the behavioral tasks as a manipulation check.

Clinical Interview Measures

Yale-Brown Obsessive-Compulsive Scale (YBOCS; Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989). YBOCS is a clinical interview designed to assess the severity of OCS in both clinical and non-clinical samples (Frost, Steketee, Krause, & Trepanier, 1995; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989). Participants first complete a 72-item symptom checklist (YBOCS-SC) that evaluates current and lifetime obsessions and compulsions. Subsequently, a semi-structured clinical interview is administered to gauge the severity of the obsessions and compulsions endorsed in the checklist. Across 10 items (5 items focused on obsession and compulsions, respectively), several indices are considered, including time spent on symptoms, functional impairment, distress, resistance, and control over symptoms. Severity items are rated by the interviewer on a 5-point scale ranging from 0 (no

symptoms) to 4 (extreme symptoms). The total score range is 0-40 and is calculated by summing up the 10 severity ratings. YBOCS exhibits satisfactory concurrent validity with established measures of OCD symptom severity (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989), and has demonstrated good internal consistency in our sample ($\alpha = .89$).

MINI Neuropsychiatric Interview, version 6.0.0. (Lecrubier et al., 1997; Sheehan et al., 1997). MINI is a structured psychodiagnostic interview evaluating the presence of 17 psychiatric diagnoses. MINI prioritizes current disorders and assesses lifetime diagnoses when relevant to the present (e.g., bipolar disorder, psychotic disorder). For each psychiatric disorder individuals are asked one or two primary screening questions, which rule out a diagnosis when answered negatively. Average administration duration is 20 minutes, making MINI a feasible instrument. MINI has demonstrated good test-retest reliability and good to acceptable concurrent validity with the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders.

Cognitive Flexibility Task

Intradimensional/Extradimensional Shift (IED) Test (*Sahakian & Owen, 1992*). IED is the computerized version of the Wisconsin Card Sorting Test and measures cognitive flexibility (also called set shifting). The task includes shifts within one dimension (intradimensional) and between two dimensions (extradimensional). The participant is presented with two images, each of which contains a colored shape and white lines. The participant chooses one of the images and is given feedback about the accuracy of his choice, based on an unknown rule. Then, the participant is presented with

two new images and is asked to choose the correct one based the feedback received in the previous trial. After 6 consecutive correct responses, the participant is considered to have established the rule. The number of trials it takes the participant to reach 6 consecutive correct responses is considered one block.

Then, the rule changes unbeknownst to the participant, which requires him to *mentally switch* to the novel rule and respond according to feedback. In blocks 1-6, the rule is based on shape dimension. At block 6, a novel set of shapes is presented and the participant has to apply the previous shape rule to these novel shapes (i.e., intradimensional set shift). At block 8, the participant is presented with novel shapes and lines like before, however, the rule changes from the shape dimension to the line dimension unlike in previous blocks (i.e., extradimensional set shift). Participants are expected to switch from the shape-based rule to the line-based rule. Following block 8, a final block tests whether the participant learned the new line dimension rule and rewards those who choose the pattern with the line that was incorrect in the preceding block. The sum of the number of errors to reach criterion at blocks 6 and 8, assessing intra- and extra-dimensional set shifting respectively, is the cognitive flexibility score and constitutes the dependent variable. IED has been shown to discriminate among individuals with and without subclinical OCS (Francazio & Flessner, 2015).

Training Conditions

Training Procedures. Participants were told that they would complete a *picture viewing task*, which involved looking at a set of images on a computer screen while mentally applying specific instructions. All experimental groups viewed a combination of positive filler, negative filler, neutral, and symptom-specific images. Experimental

condition determined the type of symptom-specific images participants saw (e.g., harm-themed images versus disgust-themed images), as well as the specific training instructions they received (see below). Each training intervention took approximately 12 minutes to complete.

Training Stimuli. The image categories used in the experiments of Papies and colleagues (2015) were adapted for this study. Both trainings consisted of viewing 40 images in two blocks. The practice block included 5 symptom specific (e.g., *urinal* for Contamination, *gun* for Harm), 5 neutral (e.g., *mug*), 5 positive filler (e.g., *seal*), and 5 negative filler (e.g., *snake*) images. The critical block consisted of 10 symptom specific and 10 neutral pictures. Images were displayed on the screen one at a time with a brief summary of the instructions above each picture for 5 seconds, at which point participants could press the space bar to continue. A blank screen appeared for 1 second between each picture. Between the practice block and the critical block, participants took a short break and were given a brief reminder of the instructions. Pictures were presented in a different random order for each participant.

Contamination images were selected from the Maudsley Obsessive–Compulsive Stimuli Set which has demonstrated excellent convergent and discriminant validity (MOCSS; Mataix-Cols, Lawrence, Wooderson, Speckens, & Phillips, 2009). Because MOCSS does not include images provoking harm related unacceptable thoughts, the *Harm images* were taken from the negative picture set of the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008). Consistent with Papies and colleagues (2012; 2015), neutral and filler images were also selected from IAPS. The specific filler stimuli used by Papies and colleagues' were included in the study to the

extent that they did not appear to provoke harm or contamination obsessions. Appendix B presents sample images used in the study.

Mindful Attention Training Condition. Participants in the MA training groups were provided with instructions on what it means to observe one's thoughts and emotions. Specifically, MA training participants were told that they may experience different types of reactions to the pictures they were about to see, such as thinking about the object displayed in the picture, whether they liked or disliked it, or how it made them feel (Papies et al., 2015). They were advised to observe their thoughts and emotions about the images as passing mental events that arise and dissipate (See Appendix C). Of note, the terms "mindfulness" or "attention" were not mentioned.

Control Training Condition. Control participants completed the exact same procedures as their MA training counterparts, with the exception of the instructions they were asked to apply during the picture viewing task. They were told that they may experience different reactions to the images they would see, and were asked to view the pictures closely and in a relaxed manner (Papies et al., 2015). Appendix D provides the script for Control training.

Picture Viewing Task Ratings

After the training, participants were shown the same set of symptom-specific and neutral images that were used during critical block (i.e., the training block). They then completed two blocks of ratings; one block of urge ratings and one block of aversiveness ratings. The order of these blocks was randomized for each participant, as were the order of pictures within each block.

Urge Ratings. Participants were asked to indicate as quickly as possible whether they had an urge to neutralize in response to each of the 40 pictures. Before beginning the urge ratings, neutralizing was defined for participants as:

“Behavioral or mental acts that you feel driven to perform although you may recognize them as senseless or excessive. They serve the purpose of decreasing anxiety or discomfort. Examples of neutralizing behaviors include having to wash your hands excessively after touching a contaminated object or reciting phrases to yourself each time you have a bad thought.”

On top each image, the question “Do you want to wash your hands right now?” appeared for Contamination groups, while Harm groups saw the question “Do you want to neutralize right now?” They had to respond yes or no within a 1 second window by using two designated keys on the keyboard. This allowed us to capture only intuitive responses. At the beginning of the urge ratings, six practice trials were completed to make sure that participants understood the instructions. Only responses given within 1 second of picture onset were recorded. There was a 1 second break between pictures. Pictures were presented in a different random order for each participant. Proportion of positive to total urges for symptom specific images ($N= 15$) was used as the dependent variable for urge ratings.

Aversiveness Ratings. Participants also rated the aversiveness of the same 40 images on a Visual Analogue Scale (VAS) ranging from 0 to 100. The questions “How disgusting is this image?” or “How frightening is this image?” appeared on top of each picture for the Contamination and Harm groups respectively. Participants indicated their responses by sliding the VAS, which reset at the middle point at the onset of each image.

Mean aversiveness of symptom specific images ($N= 15$) was used as the dependent variable for aversiveness ratings.

Behavioral Tasks

Contamination Task. Participants in the Contamination condition completed an in-vivo behavioral task, that was adapted from standardized OCD-relevant behavioral approach paradigms (Najmi, Tobin, & Amir, 2012). Specifically, participants were presented an open-lid, free-standing toilet made to look dirty with soil and food coloring. After being told that the toilet was brought to the laboratory from a construction site, participants were asked to touch the handle, the top and sides of the water tank, and the toilet seat with a tissue in each hand. Pilot testing in our laboratory showed that using a tissue elicits the greatest level of variability with approximately 50% of volunteers reporting that an urge to clean; touching the toilet seat with bare hands led all volunteers to want to wash their hands.

After participants had touched the toilet, they were asked to rate their disgust levels on a VAS labeled 0 (not disgusted) to 100 (very disgusted), reported whether they felt an urge to wash (yes/no question), and rated the strength of their urge on a VAS labeled 0 (not strong) to 100 (very strong). Then they were given the option to wash or sanitize their hands. The experimenter recorded whether the participant engaged in any neutralizing behaviors and type of ritual completed (e.g., washed hands, used hand sanitizer). Neutralizing behavior was coded as a dichotomous (yes/no) variable.

Harm Thought Task. Participants in the Harm condition completed an in-vivo behavioral task designed to provoke harm-related unacceptable thoughts, adapted from a standardized thought-action-fusion paradigms (Bocci & Gordon, 2007; Rachman,

Shafran, Mitchell, Trant, & Teachman, 1996). Participants were asked to think of a close friend or family member and to write their full name down on a blank index card. Then, they were provided with another index card with a sentence intended to evoke unacceptable thought obsessions. The sentence read “I hope _____ is in a car accident today.” Participants were instructed to copy the sentence on a blank index card and to insert the name of their loved one in the blank space. Finally, they were asked to close their eyes and to vividly visualize the scene depicted in the sentence for 30 seconds.

Following the task, participants indicated their fear levels on a VAS labeled 0 (not frightened) to 100 (very frightened), reported whether they felt an urge to neutralize (yes/no question), rated the strength of their urge a VAS labeled 0 (not strong) to 100 (very strong). Then they were given an opportunity to neutralize. The experimenter recorded whether the participant engaged in any neutralizing behaviors as a dichotomous variable (yes/no) and type of ritual completed (e.g., scratched or altered sentence, altered the sentence, reported a mental ritual).

Chapter 4: Data Analytic Plan

A Priori Power Analyses

Based on the medium effect sizes reported in the Papiers et al. (2015) studies reviewed above, it was determined that *a priori* statistical power would be estimated to test a medium effect in this study. Using the GPower statistical power analysis program (Faul & Erdfelder, 1992), it was determined that 92 participants (23 per cell) would allow for the examination of the primary aims of this study (Aims 1 and 2), at a power greater than 80% to test a medium effect size with a Type 1 error (α) < .05. A sample of 108 participants was recruited.

Preliminary Analyses

All data were screened prior to primary data analyses. Frequencies and descriptive statistics were examined for errors in data collection and entry. Hand entered data was cross-checked and corrected when necessary. Analysis of Variance (ANOVA) was used to examine any potential baseline group differences on relevant continuous variables. Chi square tests were used to examine differences on dichotomous demographic variables.

Assumptions of the statistical tests used (i.e., ANOVA and regression), influential observations, and outliers were examined in advance of primary analyses. One multivariate outlier was observed to be 4 standard deviations above the mean on OCS severity (i.e., YBOCS) and distress following the behavioral task. This participant's YBOCS and distress scores were replaced with the next highest score that is not an outlier, using a standard winsorizing approach (Field, 2013; Wilcox, 1993). Our sampling strategy was successful, in that, after winsorizing the outlier observation, YBOCS scores

were normally distributed in the sample (see Figure 3 for the distribution of YBOCS scores). Skewness and kurtosis of all variables of interest were within the limits of normality after completing this procedure (skewness < 3.0, kurtosis < 8.0; Kline, 2011).

Primary Statistical Analyses

To test aims 1 and 2, we completed a series of two-way factorial ANOVAs with training condition, OC stimulus condition, and their interaction as the independent factors. Significant interaction terms were followed up with Tukey's post-hoc comparisons to explore between-group mean differences. Across all analyses, relevant dependent variables included both the primary and secondary variables from the picture viewing task and the behavioral tasks.

For the one dependent variable that was categorical (i.e., compulsive behavior), a binary logistic regression analysis was conducted to test the main effects and interactions of training group and OC stimulus condition. Model fit was examined via the significance of chi square differences among the three models. Model 1 included training condition as the independent variable; model 2 included training condition and OC stimulus type as the independent variable and the moderator, and model 3 included training condition, OC stimulus type, and their interaction.

To examine aim 3, we conducted a series of linear regression analyses. Using the procedures outlined by Holmbeck (2002), the predictor (training condition) and the moderator (OCS severity) were centered to reduce multicollinearity and facilitate examining the simple effects. An interaction score was computed as the product of the two centered variables. The centered terms and their interaction were entered into a simultaneous regression analysis to predict the primary and secondary outcome variables

from the picture viewing task and the behavioral tasks. The analyses were conducted within each OC stimulus condition (i.e., harm and contamination) separately. Significant interactions were followed up via simple effects tests.

To test aim 4, we completed a series of linear regression analyses with cognitive flexibility, OCS severity, and their interaction as the independent variables predicting the primary and secondary outcome variables from the picture viewing task and the behavioral tasks. The same moderation procedures outlined for aim 3 (Holmbeck, 2002) were utilized to test aim 4. Only participants in the MA training group were included in the analyses as this aim focused on whether baseline levels of cognitive flexibility interacted with OCS severity to facilitate gains from the MA training.

Chapter 5: Results

Preliminary Analyses

Post-Randomization Data Exclusions. Participants who met criteria for Bipolar Disorder ($N= 3$) or Psychotic Disorder ($N= 1$) on the MINI, and individuals who endorsed current suicidal ideation ($N= 1$) were excluded, as were those who had difficulty understanding the study instructions due to not being fluent in English ($N= 1$). Please see Figure 1 for the breakdown of psychiatric exclusions across the four conditions.

A critical exclusionary criterion for this study was mindfulness/meditation experience. Exclusion decisions were made on the basis of the research question that the current study aims to answer, which is whether MA training is effective for young adults with OCS, rather than for mindfulness-naïve persons. Although individuals who considered themselves “experts” on mindfulness/meditation in the screening questionnaire were deemed ineligible, eligible individuals who participated in the study provided additional information regarding the type and duration of their mindfulness/meditation practice via an open-ended question. Responses were coded based on the type of mindfulness/meditation (i.e., camp/retreat, clubs, yoga classes, self-guided practice), and probable intensity associated with each type, as well as how current and regular the practice was. Based on this coding, we developed a four-tiered ranking: 1) no regular current or past practice, 2) regular or irregular current or past practice that *likely* includes rigorous mindfulness/meditation training, 3) past regular practice with *definite* rigorous mindfulness/meditation training, 4) current and regular practice with *definite* rigorous mindfulness/meditation training. Participants who were given a ranking

of 4 were excluded from the analyses ($N=5$), as extensive current mindfulness experience may have influenced their responses to the training. The participant flow diagram, depicted in Figure 1, lists the number of participants who were excluded per cell based on this mindfulness exclusion criterion.

Baseline Group Differences. A series of one-way ANOVAs and chi square tests were conducted to assess baseline differences among participants who were randomly assigned to the four study conditions with respect to demographic variables, mindfulness experience, OCS severity, depression and anxiety, psychiatric comorbidity, and cognitive flexibility. Mean levels on these variables, across the four groups, are summarized in Tables 1 and 2. No differences were found among the experimental groups with respect to age, $F(3,93)=.86, p=.47, h^2=.03$, sex, $\chi^2(3, N=97)=.67, p=.88$, race, $\chi^2(12, N=97)=8.87, p=.71$, ethnicity, $\chi^2(3, N=97)=4.43, p=.22$, or mindfulness experience, $\chi^2(6, N=97)=8.71, p=.19$. YBOCS severity, $F(3,93)=2.00, p=.12, h^2=.06$, cognitive flexibility, $F(3,87)=.21, p=.89, h^2=.01$, depression, $F(3,93)=.28, p=.84, h^2=.01$, and anxiety, $F(3,93)=.84, p=.48, h^2=.03$, was also comparable across groups. Similarly, between-group differences with respect to diagnoses, including OCD, $\chi^2(3, N=97)=4.17, p=.24$, major depressive disorder, $\chi^2(3, N=97)=.65, p=.89$, social anxiety disorder, $\chi^2(3, N=97)=1.85, p=.60$, substance use disorders, $\chi^2(3, N=97)=5.03, p=.17$, and generalized anxiety disorder, $\chi^2(3, N=97)=.01, p=1.00$, were not significant.

A one-way ANOVA with study condition as the factor and OBQ total score as the dependent variable revealed between-group differences with respect to OC beliefs, $F(3,93)=5.06, p<.01, h^2=.14$. Post-hoc Tukey's tests demonstrated that the MA/Harm condition had significantly ($p<.01$) lower OBQ scores than the MA/Contamination

condition, and that the Control/Harm group had significantly ($p < .05$) higher OBQ scores than the Control/ Contamination group (see Table 2). The *Post Hoc Analyses* section describes tests conducted to explore the potential effects of OBQ differences on links examined in this study. Of note, OBQ was completed at the end of the study, after the experimental procedures. Therefore, group differences in OC beliefs are not true baseline differences. See Table 4 for Pearson correlations among study variables.

Manipulation check for training. Participants' ratings of their perceived efficacy in following the training instructions was examined on a 9-point Likert type scale. In the MA training groups, the average ratings of participants' ability to observe their thoughts during the picture viewing task was 6.42 ($SD = 1.65$) and perceived success in perceiving their thoughts as mental events was 6.40 ($SD = 1.71$). In the Control training groups, mean ratings of the ability to look at the pictures closely and in a relaxed manner were 7.08 ($SD = 1.66$) and 7.33 ($SD = 1.81$) respectively. It was concluded that in all groups participants' understanding of the instructions was relatively high.

We wanted to rule out the possibility that MA training would induce more mind wandering or distraction compared to the Control condition. An independent samples t-test yielded no significant differences in mind wandering between the MA training and Control training conditions, $t(94) = .07$, $p = .94$, *Cohen's d* = .01. Similarly, a one-way ANOVA among all four study conditions (MA/Harm, MA/Contamination, Control/Harm, Control/Contamination) did not support significant differences in mind wandering scores of each experimental group either, $F(3,92) = .01$, $p = .99$, $h^2 = .00$.

Primary Analyses

Aim 1: Effects of training and OC stimulus condition on perceived aversiveness of OCD images and compulsive urges in response to the picture viewing task. It was hypothesized that training condition would have a main effect on aversiveness ratings of OCD images in response to the picture viewing task, with MA training leading to lower aversiveness ratings and compulsive urges than Control training. It was also hypothesized that OC stimulus condition would moderate the effect of training condition on the dependent variables with individuals in the MA/Harm condition reporting the lowest levels of aversiveness (the primary DV) and urges (secondary DV) compared to the other three groups.

To examine these hypotheses, we first conducted a 2 (training condition: MA, Control) x 2 (OC stimulus condition: Harm, Contamination) two-way ANOVA with perceived aversiveness as the dependent variable. The main effects of training condition, $F(1, 87) = .01, p = .91, \eta_p^2 = .00$, and OC stimulus condition, $F(1, 87) = .65, p = .42, \eta_p^2 = .01$, were not significant. The interaction term was also not significant, $F(1, 87) = 1.76, p = .19, \eta_p^2 = .02$, suggesting that aversiveness of OCD images were rated similarly across the different training group and OC stimulus condition combinations.

We next repeated this two-way ANOVA using the proportion of positive to total compulsive urges as the dependent variable. Participants who missed more than 3 of the 15 symptom specific images (i.e., more than 20% missing responses) were excluded from this analysis ($N = 8$). Similar to our findings for aversiveness ratings, the main effect of training group, $F(1, 85) = .79, p = .38, \eta_p^2 = .01$, was not significant. However, OC stimulus condition had a significant main effect on compulsive urges, $F(1, 85) = 5.3,$

$p < .05$, $\eta_p^2 = .06$, such that the Harm group ($M = .35$, $SD = .33$) reported significantly less compulsive urges compared to the Contamination group ($M = .51$, $SD = .35$). The interaction term was not significant in predicting compulsive urges, $F(1, 85) = 1.21$, $p = .27$, $\eta_p^2 = .01$.

Aim 2: Effects of training and OC stimulus condition on distress, strength of compulsive urges, and compulsive behaviors in response to behavioral tasks. It was hypothesized that training condition would have a main effect on the outcome variables for the behavioral task, with MA training leading to lower levels of distress, urge to neutralize, and compulsive behaviors following exposure to OCD stimuli compared to Control training. In a more exploratory vein, it was also hypothesized that OC stimulus condition would moderate the effects of training on the dependent variables with participants in the MA/Harm group reporting the lowest levels of distress (primary DV), urge strength, and compulsive behaviors (secondary DVs) compared to the other three groups.

To test these hypotheses, we first conducted a 2 (training condition: MA, Control) x 2 (OC stimulus condition: Harm, Contamination) two-way ANOVA with distress following the behavioral task as the dependent variable. Contrary to expectations, training did not have a significant main effect on distress, $F(1,90) = .10$, $p = .76$, $\eta_p^2 = .00$. The main effect of OC stimulus condition on distress was significant, $F(1,90) = 5.84$, $p < .05$, $\eta_p^2 = .06$, such that the Harm group ($M = 30.57$, $SD = 29.74$) reported significantly less distress than the Contamination group ($M = 44.96$, $SD = 28.21$). Consistent with our predictions, the interaction between training group and OC stimulus condition was marginally significant, $F(1,90) = 3.91$, $p = .05$, $\eta_p^2 = .04$, indicating that the effect of

training type on distress depended on OC stimulus condition. Post-hoc comparisons with Tukey's test demonstrated that the MA/Harm group ($M= 24.08$, $SD= 27.46$) reported significantly lower levels of distress compared to the MA/Contamination condition ($M= 50.09$, $SD= 29.42$), $p < .05$. However, the mean differences in distress between MA/Harm and Control/Harm ($M= 37.64$, $SD= 31.12$) and that between MA/Contamination and Control/Contamination ($M= 40.24$, $SD= 26.77$) were not significant, p 's = .21-.38. Distress levels did not significantly differ between the MA/Harm and Control/Contamination groups either, $p = .64$ (see Figure 4).

We next repeated the two-way ANOVA with urge strength as the dependent variable. Similar to our findings with distress, training condition did not have a significant main effect on urge strength, $F(1,90)=.55$, $p=.46$, $\eta_p^2 = .01$. The main effect of OC stimulus on strength of compulsive urges was significant, $F(1,90)= 23.26$, $p < .01$, $\eta_p^2 = .21$, such that the Harm group ($M= 23.20$, $SD= 28.19$) reported significantly less strong urges than the Contamination group ($M= 54.44$, $SD= 30.88$). Importantly, the interaction term was also significant, $F(1,90)=4.30$, $p < .05$, $\eta_p^2 = .05$, indicating that the effect of training type on urge strength depended on OC stimulus condition.

Tukey's post-hoc comparisons were conducted to explore the differences in urge strength across the four experimental conditions (see Figure 5). Results indicated that the MA/Harm group ($M= 15.08$, $SD= 25.26$) reported significantly less strong urges to neutralize following the behavioral task compared to either the MA/Contamination ($M= 56.61$, $SD= 29.09$), $p < .01$ and Control/Contamination ($M= 48.60$, $SD= 32.54$) conditions, $p < .01$. Contrary to expectations, urge strength levels did not significantly differ between the MA/Harm and Control/Harm ($M= 32.05$, $SD= 29.09$) groups, $p = .21$.

MA/Contamination and Control/Contamination also did not differ from one another, $p = .78$.

To test the main effects and interactions of training condition and OC stimulus condition on compulsive behaviors, a binary multiple logistic regression analysis was conducted with training group and OC stimulus condition as independent variables (i.e., covariates) and compulsive behavior as a dichotomous dependent variable. The interaction term, controlling for training condition and OC stimulus condition, was not significant, $\chi^2_{df=1} = 2.80, p = .09$. The main effect of training condition was also not significant, $\chi^2_{df=1} = .11, p = .74$. However, the main effect of OC stimulus condition was significant after controlling for training condition $\chi^2_{df=1} = 6.33, p < .05$. Post-hoc analysis indicated that the estimated odds of engaging in a neutralizing ritual in the Contamination condition was 2.94 ($\beta = 1.08, p < .05$) times the estimated odds for the Harm condition with a 95% confidence interval of [1.26, 7.10].

Aim 3: Effects of training condition and OCS severity on responses to the picture viewing and behavioral tasks—Harm Condition. The hypothesized interaction between training condition and OCS severity in response to harm themed picture viewing task was examined via a simultaneous linear regression analysis with only participants in the Harm condition. Training condition and YBOCS total scores were first centered, after which their interaction term was computed. A simultaneous multiple regression analysis was conducted with the centered variables and their interaction as the predictors, and aversiveness of the harm themed OCD images as the dependent variable. The overall model was not significant and explained 5% of the variance, $R^2 = .05, F(3,40) = .67, p = .58$. The main effect of training condition, $\beta = -.13, t(40) = -.83, p = .41$, and the main

effect of YBOCS, $\beta = .11$, $t(43) = .67$, $p = .50$, were not significant. The interaction was also not significant, $\beta = .16$, $t(40) = 1.00$, $p = .32$.

We next repeated this regression analysis with the secondary outcome variable, compulsive urges in response to the harm themed OCD images. Similar to the analysis for Aim 1, participants who missed more than 20% of the urge ratings in the Harm condition ($N = 4$) were excluded. The overall model was not significant and only explained 2% of the variance, $R^2 = .02$, $F(3,41) = .26$, $p = .86$. The main effect of training, $\beta = -.03$, $t(41) = -.20$, $p = .85$, the main effect of YBOCS $\beta = -.03$, $t(41) = -.22$, $p = .83$, and their interaction $\beta = .13$, $t(41) = .80$, $p = .43$, were not significant in predicting compulsive urges, indicating that the effect of MA training on aversiveness or compulsive urges did not differ based on OCS severity.

To examine the interaction between training group and OCS severity in response to the harm behavioral task, we repeated the regression analysis with distress as the outcome variable. The overall model was not significant and explained 11% of the variance, $R^2 = .11$, $F(3,42) = 1.65$, $p = .19$. The main effect of training, $\beta = -.22$, $t(42) = -1.47$, $p = .15$, the main effect of YBOCS, $\beta = .00$, $t(42) = .02$, $p = .99$, were not significant. The interaction was also not significant, $\beta = .23$, $t(42) = 1.56$, $p = .13$. This regression analysis was repeated with the secondary outcome variable, urge strength in response to the harm behavioral task. The overall model was not significant and explained 10% of the variance, $R^2 = .10$, $F(3,42) = 1.58$, $p = .21$. The main effect of YBOCS was not significant, $\beta = .03$, $t(42) = .22$, $p = .82$, however; the main effect of training was marginally significant $\beta = -.29$, $t(42) = -1.98$, $p = .05$. Participants in the MA training condition ($M = 15.08$, $SD = 25.26$) reported weaker urges to neutralize compared to those in the Control training

group ($M= 32.05$, $SD= 29.10$). The interaction was not significant, $\beta= .09$, $t(42)= .62$, $p= .54$, indicating that the effect of MA training on urge strength did not differ based on OCS severity.

Aim 3: Effects of training condition and OCS severity on responses to the picture viewing and behavioral tasks—Contamination Condition. To test interaction between training group and OCS severity in response to contamination themed picture viewing task, a simultaneous linear regression analysis was conducted with only participants in the Contamination condition. First, training condition and YBOCS total scores were centered, followed by a computation of their interaction term. A simultaneous multiple regression analysis was conducted with the centered variables and their interaction as the predictors, and aversiveness of the contamination themed OCD images as the dependent variable. The overall model was not significant and explained 13% of the variance, $R^2= .13$, $F(3,43)= 2.19$, $p= .10$. The main effect of training condition, $\beta= .14$, $t(43)= .96$, $p= .34$, and the main effect of YBOCS, $\beta= .08$, $t(43)= .52$, $p= .61$, were not significant. As hypothesized, the interaction was significant, $\beta= -.31$, $t(43)= -2.16$, $p<.05$. Simple effects tests were conducted to examine the effect of training at one standard deviation above and below YBOCS total scores. Results demonstrated that when OCS severity was high, there were no significant differences between the training groups on aversiveness ratings. However, when OCS severity was low, the association between training condition and aversiveness ratings was significant, such that the Control group rated the contamination images lower in aversiveness than the MA training group (see Figure 6).

We repeated this regression analysis with the secondary outcome variable, compulsive urges in response to the contamination themed OCD images. Similar to the analyses for Aim 1, participants who missed more than 20% of urge ratings in the Contamination condition ($N=4$) were excluded. The overall model was not significant and explained 14% of the variance, $R^2 = .14$, $F(3,40) = 2.24$, $p = .10$. The main effect of training, $\beta = .21$, $t(40) = 1.40$, $p = .17$, and the main effect of YBOCS, $\beta = .05$, $t(40) = .30$, $p = .77$, were not significant. The interaction was significant, $\beta = -.31$, $t(40) = -2.10$, $p < .05$. Simple effects tests demonstrated that at high OCS severity, the effect of training on compulsive urges was not significant. However, when OCS severity was low, training condition had a significant simple effect on compulsive urges in the unexpected direction, such that the MA training group reported more compulsive urges compared to the Control group, $\beta = .54$, $t(40) = 2.40$, $p < .05$ (see Figure 7).

To test the interaction between training group and OCS severity in response to the contamination behavioral task, we repeated the regression analysis with distress as the outcome variable. The overall model was not significant and explained 4% of the variance, $R^2 = .04$, $F(3,44) = .56$, $p = .65$. The main effect of training, $\beta = .16$, $t(44) = 1.06$, $p = .30$, and the main effect of YBOCS, $\beta = .07$, $t(44) = .44$, $p = .66$, were not significant. The interaction was also not significant, $\beta = -.03$, $t(44) = -.17$, $p = .86$. This analysis was repeated with the secondary outcome variable, urge strength in response to the contamination behavioral task. The overall model was not significant and explained 5% of the variance, $R^2 = .05$, $F(3,44) = .71$, $p = .55$. The main effects of training condition, $\beta = .09$, $t(44) = .60$, $p = .55$, and YBOCS, $\beta = .17$, $t(44) = 1.12$, $p = .27$, were not significant. The interaction was also not significant, $\beta = .07$, $t(44) = .44$, $p = .66$. Results suggested that

the effect of training on distress or urge strength in response to the behavioral tasks did not change depending on OCS severity for either OC stimulus condition.

Aim 4: Interaction between OCS severity and cognitive flexibility in predicting responses to the picture viewing and behavioral tasks in the MA training condition. For this aim, it was expected that cognitive flexibility would only be employed by participants in the MA training condition, because MA, but not Control training, required a mental shift in perspective *from* habitually reacting to OC-stimuli *to* observing reactions nonjudgmentally. Therefore, Aim 4 was examined with participants in the MA training condition only. The harm and contamination conditions were collapsed together based on research findings linking cognitive inflexibility to OCS in general (Abramovitch et al., 2013), rather than to a specific symptom dimension.

It was hypothesized that cognitive flexibility would moderate the effect of OCS severity on the outcome variables of the picture viewing task, with participants with high cognitive flexibility and low OCS severity reporting the lowest aversiveness ratings and compulsive urges in response to OCD images in the MA training condition. It was also hypothesized that cognitive flexibility would moderate the effect of OCS severity on the outcome variables of the behavioral tasks, with participants with high cognitive flexibility and low OCS severity reporting the lowest distress and urge strength.

To test these hypotheses, we employed a series of linear regression analyses with only participants in the MA training condition. IED shift errors and YBOCS total scores were first centered. Then their interaction term was computed. A simultaneous multiple regression analysis was conducted with the centered variables and their interaction as the predictors, and aversiveness of the picture viewing task images as the

dependent variable. The overall model was not significant and explained 9% of the variance, $R^2 = .09$, $F(3,37) = 1.20$, $p = .32$. The main effect of YBOCS, $\beta = .20$, $t(37) = 1.18$, $p = .25$, and the main effect of cognitive flexibility, $\beta = -.02$, $t(37) = -.14$, $p = .89$, were not significant. The interaction was not significant either, $\beta = .28$, $t(37) = 1.72$, $p = .09$.

The regression analysis was repeated with the secondary outcome variable, compulsive urges in response to the picture viewing task images. Similar to the analysis for Aim 1, participants who missed more than 20% of urge ratings in the Contamination condition ($N = 4$) were excluded. The overall model was not significant and explained 1% of the variance, $R^2 = .01$, $F(3,40) = .14$, $p = .94$. The main effects of YBOCS, $\beta = .06$, $t(40) = .34$, $p = .73$, and cognitive flexibility, $\beta = .02$, $t(40) = .12$, $p = .90$, were not significant. The interaction was also not significant, $\beta = -.07$, $t(40) = -.45$, $p = .66$, suggesting that the effect of OCS severity on aversiveness ratings and compulsive urges did not change with varying levels of cognitive flexibility.

We then repeated the linear regression analysis with distress in response to the behavioral task as the dependent variable. The interaction terms were not significant, $\beta = .08$, $t(42) = .56$, $p = .58$ and $\beta = -.13$, $t(42) = -.92$, $p = .36$. The overall model was not significant and explained 12% of the variance, $R^2 = .12$, $F(3,42) = 1.95$, $p = .14$. The main effect of YBOCS, $\beta = .35$, $t(42) = 2.33$, $p < .05$ was significant, such that as OCS severity increased, so did distress in response to the behavioral task. The main effect of cognitive flexibility was not significant, $\beta = .15$, $t(42) = 1.03$, $p = .31$. The interaction was also not significant, $\beta = .08$, $t(42) = .56$, $p = .58$.

Finally, the linear regression analysis was then repeated with urge strength in response to the behavioral task as the secondary dependent variable. The overall model was significant and explained 17% of the variance, $R^2 = .17$, $F(3,42) = 2.90$, $p < .05$. The main effect of YBOCS, $\beta = .36$, $t(42) = 2.49$, $p < .05$ was significant, such that as OCS severity increased, so did urge strength in response to the behavioral task. However, the main effect of cognitive flexibility, $\beta = .05$, $t(42) = .34$, $p = .73$, and the interaction, $\beta = -.13$, $t(42) = -.92$, $p = .36$ were not significant (see Table 3).

Post Hoc Analyses

Observed Power. Observed power was calculated based on final sample size using the GPower statistical power analysis program (Faul & Erdfelder, 1992). The main study hypotheses for aim 1 and 2 were powered at 68% with a Type 1 error (α) $< .05$. Aims 3 and 4 were powered at 26% with a Type 1 error (α) $< .05$.

Between-Group Differences in OBQ Scores. Due to the significant between-group differences in OBQ total scores between the MA/Harm and Control/Harm conditions, as well as the Control/Harm and Control/Contamination groups, we repeated all analyses controlling for OBQ total scores. Though the pattern of results largely remained the same, two of the significant effects became nonsignificant. An analysis of covariance (ANCOVA) testing the effects of training condition and OC stimulus condition on distress following the behavioral task, with OBQ total as a covariate, yielded a nonsignificant interaction term, $F(1,89) = 1.49$, $p = .23$, $\eta_p^2 = .02$. The ANCOVA was repeated with the secondary dependent variable of the behavioral task, urge strength. Similarly, the interaction was not significant, $F(1,89) = 1.66$, $p = .20$, $\eta_p^2 = .02$, after controlling for OBQ total scores.

Mood Ratings Across the Experimental Conditions. We examined whether the four conditions elicited meaningful differences with respect to mood ratings; see Figure 8 for an illustration of pre- to post-behavioral task changes in affect per experimental condition. First we computed a change score by subtracting the anxiety ratings that were obtained before the behavioral task from those that were obtained after the behavioral task. Next, we examined the increases in negative affect among the two behavioral tasks. Three paired sample t-tests were conducted to examine the significance of mean differences in anxiety, sadness, and irritability from pre- to post-behavioral tasks. Results revealed that anxiety levels following the behavioral task ($M= 2.85, SD= 1.74$) were significantly higher than those before the task ($M= 1.97, SD= 1.24$), $t(95)= 5.95, p < .01$, *Cohen's d* = .58. In addition, sadness also increased significantly from before ($M= 1.15, SD= .46$) to after the behavioral task ($M= 2.36, SD= 1.76$), $t(95)= 7.08, p < .01$, *Cohen's d* = .94. Finally, irritability levels also were significantly higher after the task ($M= 2.15, SD= 1.56$) than those before ($M= 1.56, SD= .95$), $t(95)= 4.31, p < .01$, *Cohen's d* = .46.

Next, we examined changes in negative affect among the four experimental conditions. A one-way ANOVA was performed with study condition as the independent variable and change in anxiety as the dependent variable. The overall model was significant, $F(3.92)= 7.04, p < .01, h^2 = .19$. Post-hoc multiple comparisons with Tukey's test revealed that the MA/Harm group ($M= 1.33, SD= 1.31$) did not report significantly greater increases in anxiety compared to the Control/Harm ($M= 1.67, SD= 1.83$) group, $p=.82$. Similarly, the MA/Contamination ($M= .30, SD= 1.26$) and Control/Contamination ($M= .24, SD= .72$) conditions were not significantly different, $p=.10$. Comparing across OCS stimulus condition, we found that the MA/Harm group reported significantly greater

increases in anxiety compared to the MA/Contamination and Control/Contamination conditions, p 's $< .05$. Similarly, mean anxiety differences between the Control/Harm and Control/Contamination, and Control/Harm and MA/Contamination groups were significant, p 's $< .01$. These comparisons indicate that the Harm condition, regardless of training type, elicited greater increases in anxiety than the Contamination condition.

We repeated this one-way ANOVA with changes in sadness scores from before to after the behavioral task as the dependent variable. The overall model was significant, $F(3.92) = 32.22$, $p < .01$, $h^2 = .51$. Post-hoc multiple comparisons with Tukey's test revealed that the MA/Harm group ($M = 2.29$, $SD = 1.57$) reported significantly greater increases in sadness compared to either the MA/Contamination ($M = .04$, $SD = .21$) and Control/Contamination ($M = .00$, $SD = .29$) conditions, p 's $< .01$. Similarly, mean sadness increase between Control/Harm ($M = 2.54$, $SD = 1.77$) and Control/Contamination was significant, as were the difference between the MA/Contamination and Control/Harm groups, p 's $< .01$. However, the differences in sadness increase between MA/Harm and Control/Harm were not significant, $p = .88$. Similar to increases in anxiety, these comparisons demonstrate that the Harm condition elicited greater increases in sadness than the Contamination condition.

Finally, the one-way ANOVA was repeated with changes in irritability as the dependent variable. The overall model was significant, $F(3.92) = 6.60$, $p < .01$, $h^2 = .18$. Post-hoc multiple comparisons with Tukey's test revealed that the MA/Harm group ($M = 1.00$, $SD = 1.47$) reported significantly greater increases in irritability compared to the MA/Contamination ($M = -.08$, $SD = .10$) condition, $p < .05$. Mean irritability differences between the MA/Contamination and Control/Harm ($M = 1.25$, $SD = 1.57$) groups were

significant, $p < .01$ as were those between the Control/Harm and Control/Contamination ($M = .16$, $SD = .58$) groups, $p < .05$. However, the differences in irritability increase between MA/Harm and Control/Contamination, and those between MA/Harm and Control/Harm were not significant, p 's = .08- .89. Similar to results with anxiety and sadness, it was found that the Harm condition increased irritability significantly more than the Contamination condition.

Past mindfulness experience. We wanted to rule out the possibility that participants with some past mindfulness experience may have responded differently to the picture viewing and behavioral tasks *because of* their previous extensive mindfulness experience. All primary analyses were conducted a second time, excluding individuals who had endorsed some past mindfulness practice (i.e., rated 3 on mindfulness experience, $N = 8$). The pattern of results was exactly the same across all analyses; therefore the findings reported in this document include these individuals.

Chapter 6: Discussion

The primary aim of the current investigation was to examine the effects of MA training on responses to harm- and contamination-based intrusive thoughts using a 2 (training condition: MA, Control) by 2 (OC stimulus condition: Harm, Contamination) factorial design. Given the theoretical similarities between appetitive and aversive urges, we intended to find out whether the beneficial effects of MA training for appetitive urges documented by Papies and colleagues (2012; 2015) would apply to compulsive urges. The effect of the training was examined in relation to a picture viewing task via aversiveness ratings of symptom-provoking images, and the proportion of compulsive urges to neutralize upon viewing the pictures. We also explored distress, urge strength, and compulsive behaviors following an in-vivo symptom provocation paradigm. Additionally, we sought to understand whether symptom-related and person-level factors, such as OCS severity and cognitive flexibility, moderated the effectiveness of MA training on behavioral outcomes.

Our findings demonstrated that MA appears to operate differently for OC urges than it does for appetitive urges. Papies and colleagues' (2012; 2015) MA training was adapted in this study to address intrusive thoughts and aversive urges that are associated with OCS. We were unable to replicate the results of Papies and colleagues' studies (2012; 2015) where MA training was found to lead to lower levels of approach urges and behavior across computerized and real-world tasks. Although effects of MA training did not appear to differ between the harm-themed and contamination-themed stimuli, when the outcomes were examined based on OC stimulus type—regardless of training condition—it was found that harm-themed images elicited less compulsive urges,

compared to contamination-themed images. In the context of in-vivo behavioral task outcomes, participants who completed the harm behavioral task reported significantly lower levels of distress and less compulsive urge strength than those who completed the contamination behavioral task, regardless of training group. However, the differences in distress and urge strength were not significant between either the MA/Harm and Control/Harm groups or the MA/Contamination and Control/Contamination groups, preventing us from drawing firm conclusions regarding the relative benefit of MA training compared to Control training for compulsive urges. Though distress and urge strength scores in the MA/Harm condition were significantly lower than those in the MA/Contamination group, these differences did not remain significant controlling for OC beliefs. Of note, OC beliefs were measured after the experimental manipulation rather than in the beginning of the study. Therefore, the possibility that training condition influenced participants' self-reported OC beliefs cannot be ruled out, suggesting that the lower distress and urge strength reported in the MA/Harm group may be attributable to MA training being more effective for unacceptable thoughts compared to contamination-based OCS, rather than differences in OC beliefs of each group.

A number of points may account for the divergence of our findings from those of Papias and colleagues (2012; 2015). To begin with, it is possible that negative emotions (e.g., fear, disgust) that are elicited by OCS-provoking stimuli render it more challenging to override a compulsive urge via MA compared to positive emotions associated with appetitive stimuli. This explanation is consistent with findings of a recent study where participants who underwent a negative emotion induction following a brief mindfulness

intervention found it harder to use emotion regulation strategies than those who experienced a positive emotion induction (Watford & Stafford, 2015). Of note, in the same study, both groups reported decreases in emotional avoidance, with no significant differences between the groups.

An additional consideration for the divergence between our results and those of Papiés and colleagues' (2012; 2015) is the differences in sampling methodology. While Papiés et al. used healthy college students, our sample included participants with clinical symptoms. Specifically, the sample of the present study included persons with comorbid psychiatric conditions (e.g., depression) and substantial levels of OCS (35% met for subclinical OCD and 10.3% met for a clinical diagnosis of OCD). Emotion regulation deficits that are associated with these psychiatric conditions may have made it harder for our participants to follow the MA training instructions and/or to employ MA in subsequent experimental tasks. Future studies may benefit from having participants practice mindfulness first with pleasant emotions before negative emotions or incorporating emotion regulation strategies prior to receiving MA training.

Several plausible explanations may account for the finding that harm- and contamination-themed images were rated comparably on their aversiveness, but elicited different levels of compulsive urges. First, the picture viewing ratings were phrased slightly differently for the Harm and Contamination conditions. For harm-themed images, participants reported the extent to which they found the pictures *frightening* and rated their *urge to neutralize*. For contamination-themed images, participants rated how *disgusting* the images were and reported whether they had an *urge to wash or sanitize their hands*. Furthermore, the fear- and disgust-inducing qualities of the pictures (i.e.,

aversiveness ratings) were reported by participants in an untimed manner, whereas the presence or absence of compulsive urges had to be provided within 1 second of image onset as a yes/no response. Thus, participants' report of greater proportion of urges in the Contamination compared to the Harm condition may suggest that the human mind is faster to make a connection between disgust and washing/sanitizing compared to linking fear and neutralizing. In other words, feeling repulsed by an external stimulus drives an automatic urge to clean for many people (Curtis, 2007). In contrast, feeling scared may drive an array of responses (e.g., fight or flight; Misslin, 2003), of which, an urge to neutralize may not be the first and readily accessible in mind. An alternative response to an aversive stimulus that is robustly associated with OCS is the urge to avoid (McKay et al., 2015). Future studies should assess avoidance urges in addition to compulsive urges.

A second explanation for the lack of concordance between the harm and contamination ratings, is that unacceptable thoughts may be challenging to provoke via pictures (Mataix-Cols et al., 2009). Compared to other OC symptom dimensions, unacceptable thoughts usually enter into consciousness unexpectedly without a trigger, and when there is an external trigger, it is less likely to be logically connected to the content of the intrusive thought (Lee & Kwon, 2003). Thus, in the current study, viewing images of harmful stimuli may not have provoked intrusive thoughts related to causing harm to loved ones. In addition, unacceptable intrusive thoughts are idiosyncratic. As a result, it may be that viewing images of potentially harmful objects in the present study did not provoke *one's own* unacceptable thoughts, regardless of the aversiveness of the pictures (e.g., urge elicited by a gun image versus the mental image of killing a loved one

with a gun). This would explain why participants may have considered the harm-themed images frightening but not necessarily provoking an urge to neutralize the fear. Put differently, one can rate the image of a gun image as frightening because of one's own intrusive thoughts about causing harm to self or others with a gun *or* because a gun is a lethal weapon. The former is more likely to result in an urge to neutralize for individuals at risk for OCD than the latter. In the Contamination condition on the other hand, the feeling of disgust elicited by the image of a dirty toilet may have been associated with a uniform interpretation among participants (i.e., a dirty toilet is a source of contamination), resulting in greater urges to neutralize among those who found the images disgust provoking.

The outcomes of the behavioral tasks were partly consistent with those of the picture viewing tasks. MA training and Control training participants reported similar distress levels and urge strength; however, the harm behavioral task provoked less distress, urge strength, and compulsions than the contamination behavioral task, independent of training group. Compulsions serve the purpose of reducing the distress associated with intrusive thoughts (APA, 2013). Thus, the behavioral tasks needed to elicit negative affect in order for a compulsive urge to surface. To rule out the possibility that the absence of negative affect following the harm task accounted for the lower distress and urge strength scores, pre- to post-behavioral task changes in anxiety, sadness, and irritability were examined. Results demonstrated that the harm behavioral task increased all three emotions significantly more than the contamination task, lending support to the effectiveness of the task. Disgust levels were assessed only after the contamination behavioral task and not the harm behavioral task. Our findings regarding

higher urge strength ratings in the contamination behavioral task is consistent with the greater number of compulsive behaviors in this group. Nonetheless, the omission of a pre- to post-behavioral task questionnaire assessing a *comprehensive* range of emotions in both the harm and contamination behavioral task conditions prevents us from conclusively stating that both tasks elicited comparable levels of negative affect. Future studies should obtain uniform mood ratings before, during, and after behavioral tasks. In addition, assessing participants' cognitive appraisal of their mood changes may allow for examining how behavioral tasks lead to the outcomes of interest (i.e., whether emotion or cognitive appraisal is primary in driving the effects of the task).

OC stimulus type moderated the effect of training condition on distress and urge strength, though these results did not remain significant controlling for OC beliefs. Moreover, the outcomes were not significantly different between the MA training and Control training of each OC stimulus type. The absence of a significant difference between the distress and urge strength scores of the MA/Harm and Control/Harm conditions may, at a first glance, suggest that the MA training was not effective in reducing the fear response and the strength of neutralizing urges associated with unacceptable intrusive thoughts. However, this interpretation should be made with caution given that participants in the Control/Harm group had significantly higher OC beliefs than those in the MA/Harm group, raising the possibility that the brief MA training was not powerful enough to break the link between intrusions and habitual responses for individuals who held strong beliefs regarding the importance and control of thoughts. This interpretation is consistent with poorer treatment response being documented for OCD patients who exhibit overvalued ideation (Neziroglu, Pinto,

Yaryura-Tobias, & McKay, 2004; Neziroglu, Stevens, McKay, & Yaryura-Tobias, 2001). Alternatively, MA training may indeed be more effective for unacceptable thoughts compared to contamination-based OCS, because OC beliefs were measured after the experimental manipulation rather than in the beginning of the study, suggesting that they were not true baseline differences between the experimental groups.

Distress and urge strength ratings were lower in the MA/Harm group than those in the Control/Harm group. Though the differences were not significant, the fact that they were in the expected direction lends a modest amount of support for the potential benefits of MA training for unacceptable thoughts. A different possibility is that the training was far too removed in time from the behavioral task (~10 minutes) to observe the effects of MA training. In order to mirror the study design of Papies and colleagues (2015), participants were not provided with reminders of the training instructions before the behavioral task. Future studies may offer booster instructions when the design includes multiple tasks. To rule out the possibility that the effect of MA training on the behavioral task outcomes was negligible, upcoming investigations may examine outcomes among experimental groups where participants hold comparable levels of OC beliefs.

In contrast to our predictions, the effects of training condition on compulsive behavior were not different between the harm and contamination behavioral tasks. Nonetheless, participants were less likely to engage in rituals following the harm behavioral task compared to the contamination one. This is consistent with extant literature demonstrating that individuals with unacceptable thoughts are less likely to report compulsions (Baer, 1994), partly due to the presence of mental compulsions in this group (Williams et al., 2011). We sought to overcome this phenomenon by explicitly

asking about covert rituals. It is possible that some participants did not recognize the neutralizing nature of a mental strategy they used or simply underreported it. Of note, the harm behavioral task is a well-established assessment of neutralizing that has been used in numerous studies of OCD (Berman, Abramowitz, Pardue, & Wheaton, 2010; Bocci & Gordon, 2007; Rachman et al., 1996). Therefore, its potential limitations are not unique to this study.

With respect to the distress ratings, one viewpoint to consider is that participants in the harm condition rated their *fear*, whereas the contamination group rated their *disgust* levels immediately after the behavioral task. Fear and disgust were chosen because they represent the core emotions underlying unacceptable thoughts and contamination concerns respectively (Melli, Aardema, & Moulding, 2016; Olatunji, Sawchuk, Lohr, & de Jong, 2004). However, the fact that neither group was asked to rate the emotion that was rated by the other group and that only fear and disgust were assessed prevent us from ruling out that other emotions may have had an effect in behavioral task responses (e.g., guilt for the harm task).

Based on Papiers' findings on the influence of motivational traits on intensifying appetitive urge intensity (2015), it was important to understand factors that may affect the strength of OC-relevant aversive urges. As greater psychiatric symptom severity is associated with lower levels of perceived control over symptoms (e.g., Peris et al., 2010), OCS severity was conceptualized as a motivational trait underlying compulsive urges. Our hypothesis that high OCS individuals in the Control training group would report more maladaptive responses on all task outcomes was not supported. The main effects and interactions of OCS severity and training condition in predicting distress and urge

strength in response to the contamination behavioral task was not significant. For the harm behavioral task, however; participants in the MA training group reported lower urges to neutralize than those in the Control training condition, providing some support for the benefits of MA training for unacceptable thoughts in reducing compulsive urge strength. Importantly, the between-group differences were only marginally significant for urge strength and non-significant for distress levels.

OCS severity did not influence the outcomes of the harm-themed picture viewing task. However, for the contamination-themed picture viewing task at low OCS severity, both aversiveness ratings and compulsive urges to wash/sanitize were significantly greater in the MA training condition compared to the Control training group. At high OCS severity, the differences between mean aversiveness and urges were not significantly different from one another; however, differences were in the predicted direction, with MA training leading to lower aversiveness and urge ratings than Control training. Though these findings were unexpected, they were consistent with Contamination group participants scoring higher on the outcomes than the Harm group, with the MA/Contamination group reporting the highest distress and urge strength. The consistency in the elevated scores of the MA/Contamination condition across the picture viewing and behavioral tasks raises the question of whether MA training may have an adverse effect on the contamination symptom dimension of OCS. Observing contamination driven washing urges without acting on them may be against human nature given the evolved disease-avoidance function of disgust (Oaten, Stevenson, & Case, 2009). Although ERP also necessitates withholding compulsions, patients presumably understand the rationale for doing so prior to carrying out exposures. In

contrast, the current study did not provide psychoeducation or a rationale for applying MA to disgust-provoking images, in order to mirror the procedures of Papies and colleagues. Future studies may consider supplementing MA training instructions with a clear rationale. We also considered that the high percentage of females in our sample (58%) may have contributed to the high aversiveness and urge strength ratings of contamination stimuli due to females exhibiting higher disgust sensitivity (Charash & McKay, 2002). However, this possibility was reduced by the absence of significant differences in aversiveness, distress, and urge strength ratings between males and females.

Due to the relationship between cognitive inflexibility and OCD (D'Alcante et al., 2012; Francazio & Flessner, 2015), we explored cognitive flexibility as a moderator of OCS severity on task outcomes in the MA training condition. Findings did not lend support to our prediction; results demonstrated that cognitive flexibility did not moderate the effect of OCS severity on the outcomes of either the image viewing or behavioral tasks. The assessment of cognitive flexibility in the current study is worth noting. The IED is a measure of set shifting and does not yield a separate measure of inhibition. Though prepotent responses need to be inhibited to successfully shift mental sets, the IED is untimed and therefore does not provide information on inhibition deficits. This may have interfered with our ability to assess true differences in cognitive flexibility, particularly in a nonclinical sample. Prospective studies may consider employing a timed cognitive flexibility task.

Importantly, the absence of a significant negative correlation between IED and YBOCS suggests that IED lacked convergent validity in the current study. Our non-

significant findings on cognitive flexibility are inconsistent with previous research demonstrating that IED distinguished between individuals with and without OC-behaviors (Francazio & Flessner, 2015), though the combination of body-focused repetitive behaviors and OCS in that study may have influenced the results. Despite cognitive inflexibility being recognized as a core feature of OCD (Chamberlain, Fineberg, Blackwell, Robbins, & Sahakian, 2006; Menzies et al., 2007), it is possible that other executive functions are more relevant to assessing the efficacy of MA training in a sample exhibiting predominantly subclinical OCS. Future research could investigate sustained and selective attention as moderators of a brief MA intervention.

The results of this study should be considered in light of several limitations. First, it is unclear whether the images used in the harm-themed picture viewing task successfully provoked unacceptable thoughts, suggesting that the higher aversiveness ratings of contamination-themed images should be interpreted with caution. Second, MA training instructions were not repeated before the behavioral tasks, raising the question of whether participants remembered to apply MA while completing the behavioral tasks. Third, despite the dimensional distribution of OCS in the population (Olatunji et al., 2008), the relationship between OCS and other constructs may be qualitatively or quantitatively different along the continuum of symptom severity. Thus, replication of our study with a clinical sample of OCD patients is necessary to inform treatment research. Additionally, our sample was 58% female. Though the even gender distribution among the experimental conditions reduces the possibility of gender-driven between-group differences on the outcomes, future studies should aim to obtain an even gender split given the 1:1 male to female ratio in OCD (Karno & Golding, 1991).

Of note, participants were not matched to OC stimulus types based on their self-reported OCS in the current study. Given the absence of previous research on the differential efficacy of MA training on OC symptom dimensions, the dimensional nature of OCS, and the nonclinical nature of our sample, we refrained from introducing a systematic bias in the study design. Individuals can experience more than one symptom dimension at varying frequency and intensities and the symptoms being nonclinical meant for most participants that it was not a straightforward task to identify a “primary” OCS. While this reduced the possibility of systematic errors, it is possible that some individuals scored lower on the outcome variables due to their lack of difficulty with the particular OC stimulus type they engaged with. Our design did not allow us to explore whether the results would have been different had participants only completed the training and tasks that matched their main OCS, a quest that upcoming studies should address.

In addition to the directions for future research noted above, studies should examine the effects of MA training on other OC symptom dimensions. Standardized image sets exist for both checking and symmetry symptoms, lending them conducive for an MA training task. It was noted above that the fear linked with unacceptable thoughts may lead to avoidance urges rather than compulsive urges for some individuals. Therefore, a task that assesses avoidance, such as the Approach-Avoidance Task (AAT; Rinck & Becker, 2007), may be more suitable to capture responses to unacceptable thoughts. In the AAT, participants respond to stimuli as quickly and accurately as they can based on the color or shape of the frame within which they appear. Each response leads to the image growing or shrinking, simulating approach and avoidance respectively

(Bamford & Ward, 2008). Testing the reaction time for aversive stimuli can reveal avoidance tendencies, and examining avoidance in relation to MA training and OCS dimensions may inform links between MA, perceptions of aversiveness, and behavioral tendencies.

Although the sample of this study comprised individuals experiencing differing levels of OCS severity, a number of clinical implications are important to consider here. If aversive urges are indeed harder to observe mindfully and with acceptance, creating a hierarchy of urges and practicing the use of MA with urges that are lower on the hierarchy (i.e., easier to withhold) may be beneficial. For instance, patients can first practice MA when experiencing an urge to eat an appetitive food item (e.g., donut), before using MA for compulsive urges. Further, the duration of the MA training may need to be augmented in order to observe effects, given that most effective mindfulness-based interventions last longer than a 12-minute session (Strauss et al., 2014). Finally, it may be important to provide a rationale for the MA training, to elicit more motivation and meaningful effort from participants.

This study was the first to experimentally test the effects of a brief computerized MA training on exposure to symptom-provoking stimuli using a sample of young adults who were at risk for OCD. OCD patients cannot benefit from ERP unless they are willing to participate in exposures, which a number of individuals are ambivalent to try (Maltby & Tolin, 2005). It was conceived that MA could be used as a supportive tool for ritual prevention during exposures. MA training was chosen due to its emphasis on cultivating the ability to introduce a purposeful space between thought and action, which contrasts the habitual way of responding to intrusions with compulsive rituals. The results of this

investigation suggest that MA training works differently for compulsive urges that motivate avoidance behavior compared to approach-driven appetitive urges. This distinction is evident in our data, which did not support the use of MA training over and above a relaxation-based training for compulsive urges for either unacceptable thoughts or contamination concerns. Nonetheless, our findings provide *some* preliminary support for using MA training for unacceptable thoughts relative to contamination concerns. The strength of OC beliefs appears to be important in the relationship between MA training and adaptive responses to OCS triggers. More experimental investigations are required to carefully assess the potential of MA training as a cognitive tool to support engagement in OCD exposures and/or as a stand-alone treatment. Understanding the interplay between MA, OC beliefs, and OCS dimensions is a meaningful starting point in guiding future studies on mindfulness and OCS.

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Figures

Figure 1. CONSORT flow diagram.

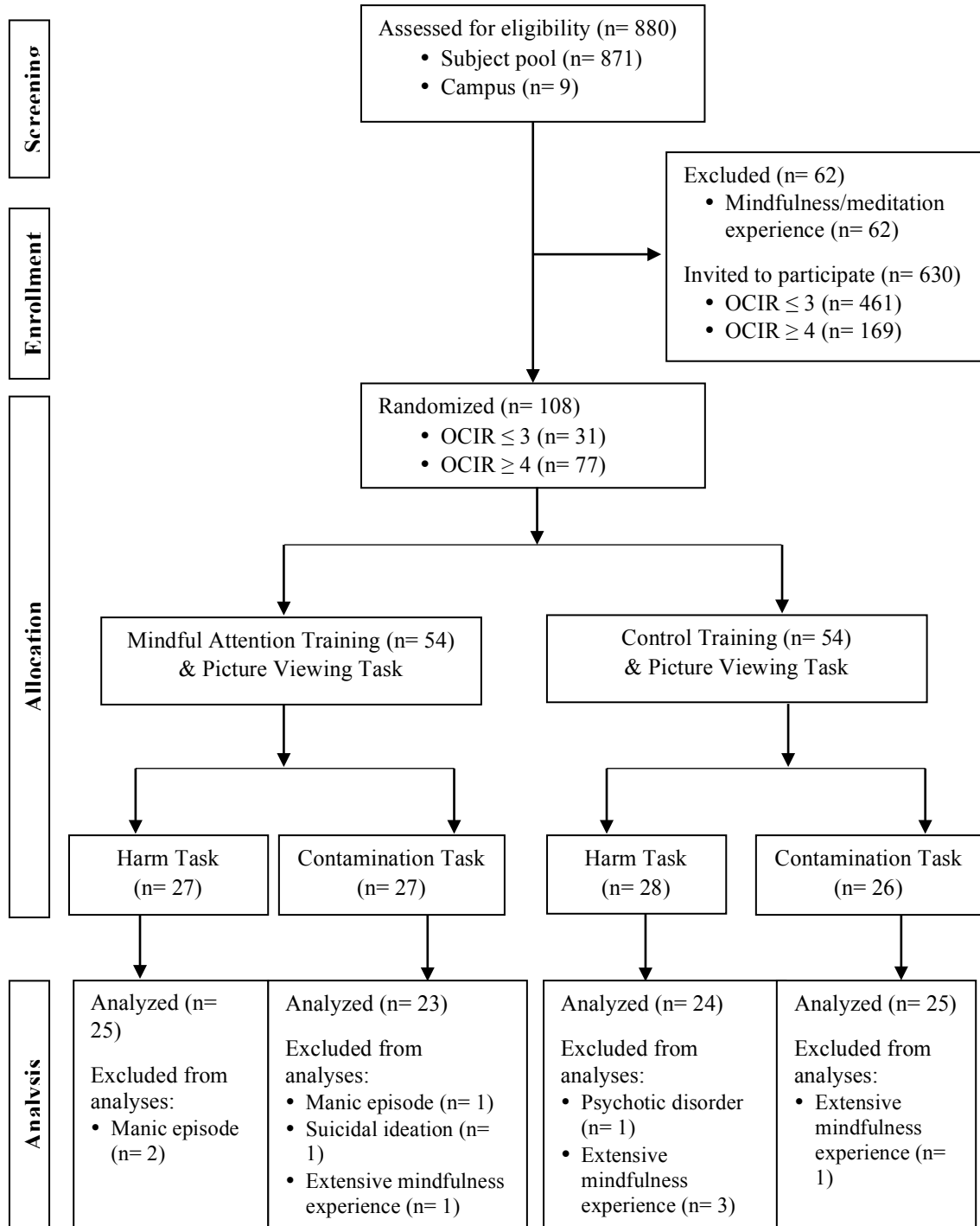


Figure 2. Study schematic. White colored squares reflect tasks that were the same across all participants. Purple colored squares include tasks specific to the Mindful Attention (MA) condition, while blue colored squares reference tasks specific to the Control condition.

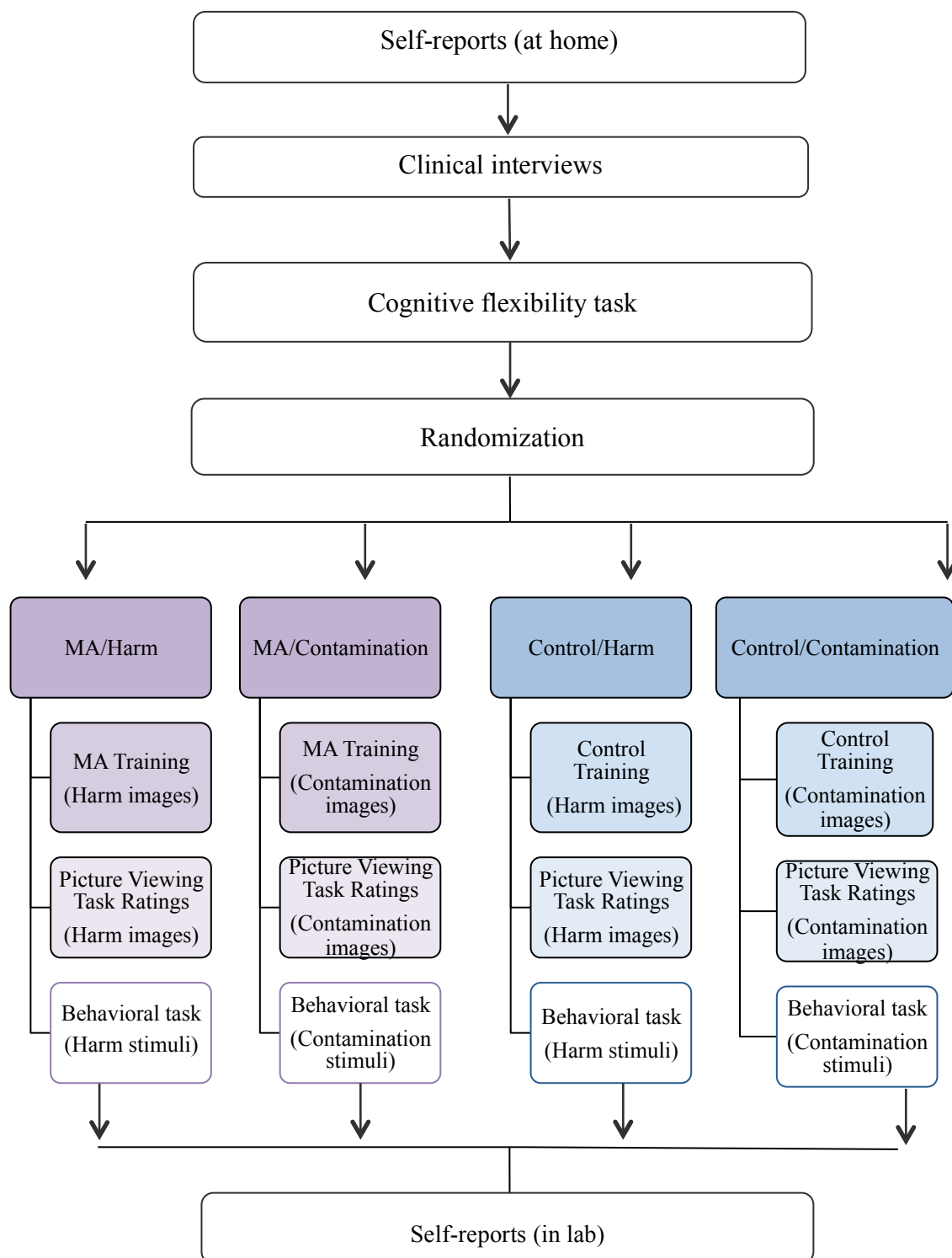


Figure 3. Frequency histogram of Yale-Brown Obsessive Compulsive Scale (YBOCS) scores

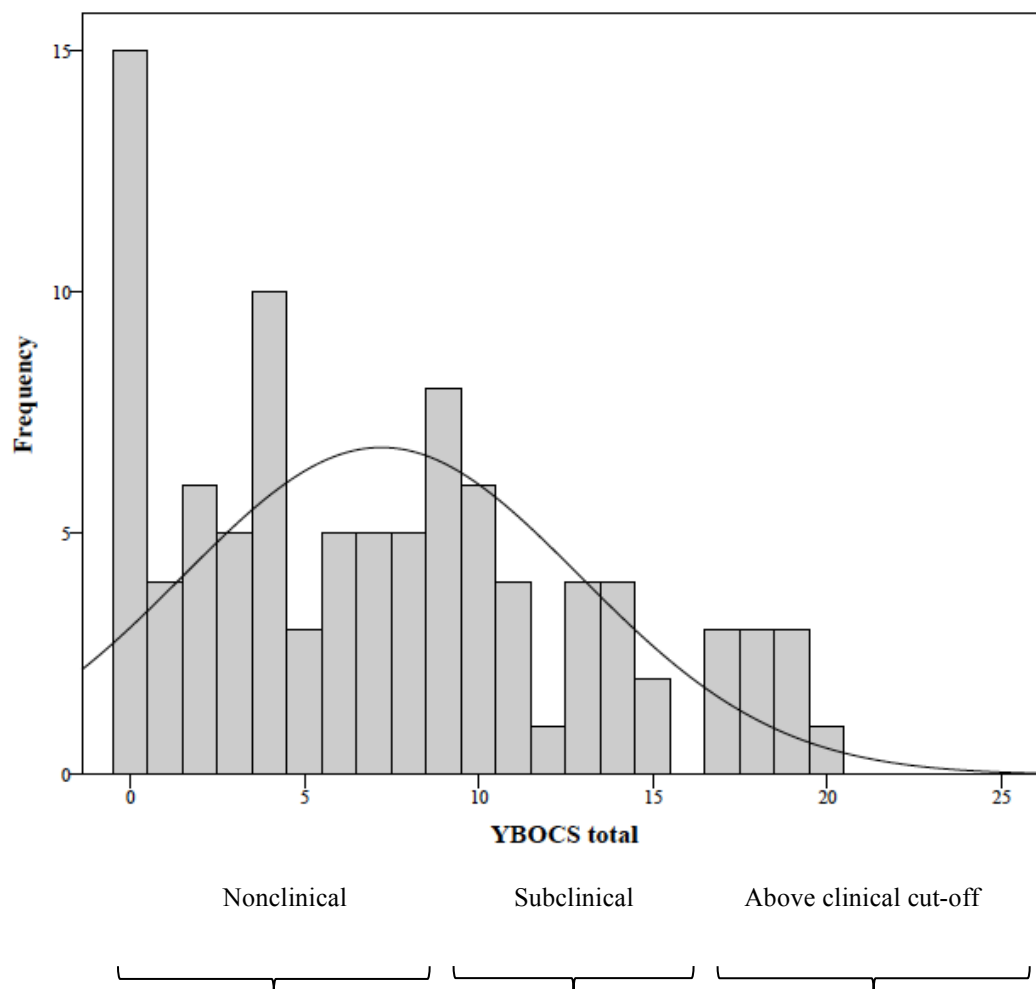
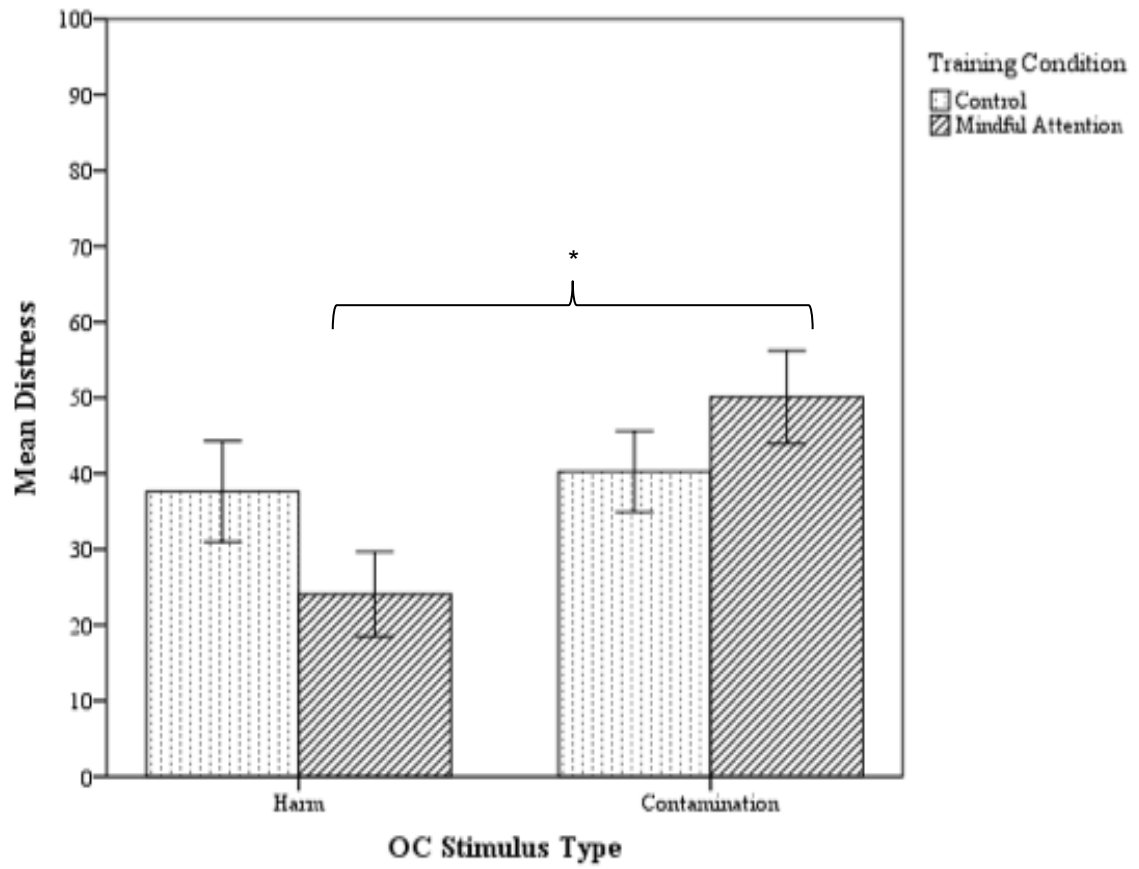
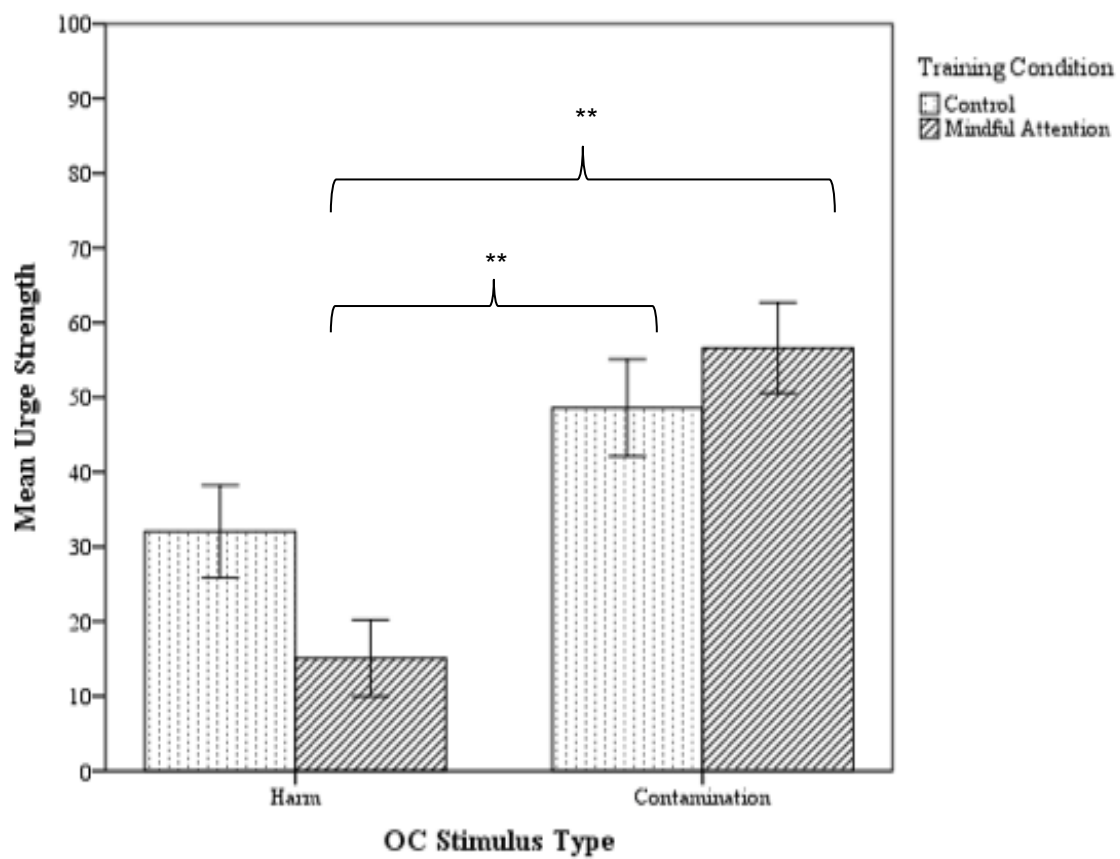


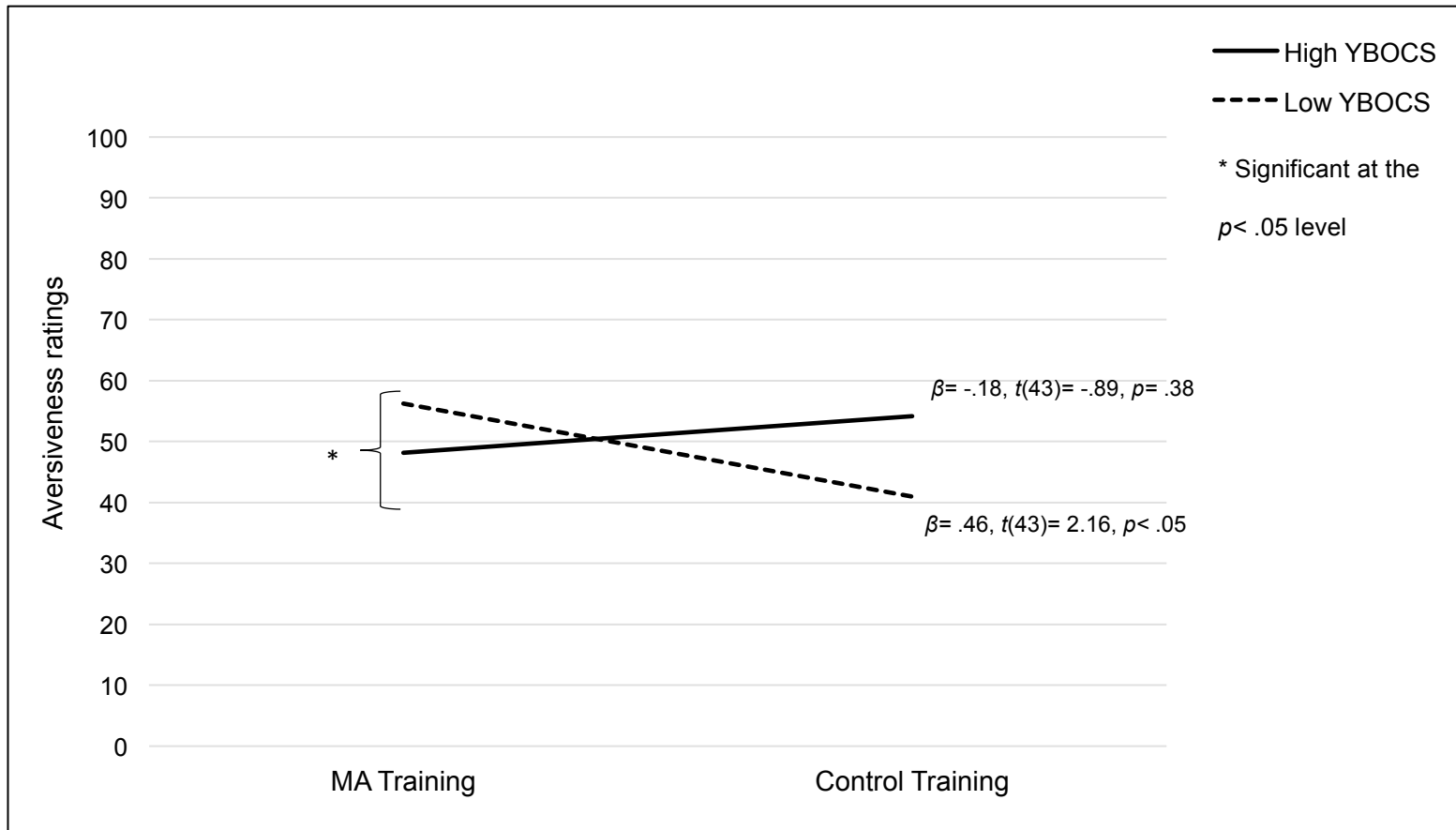
Figure 4. Post-behavioral task distress levels

*Significant at the $p < .05$ level

Figure 5. Post-behavioral task urge strength levels

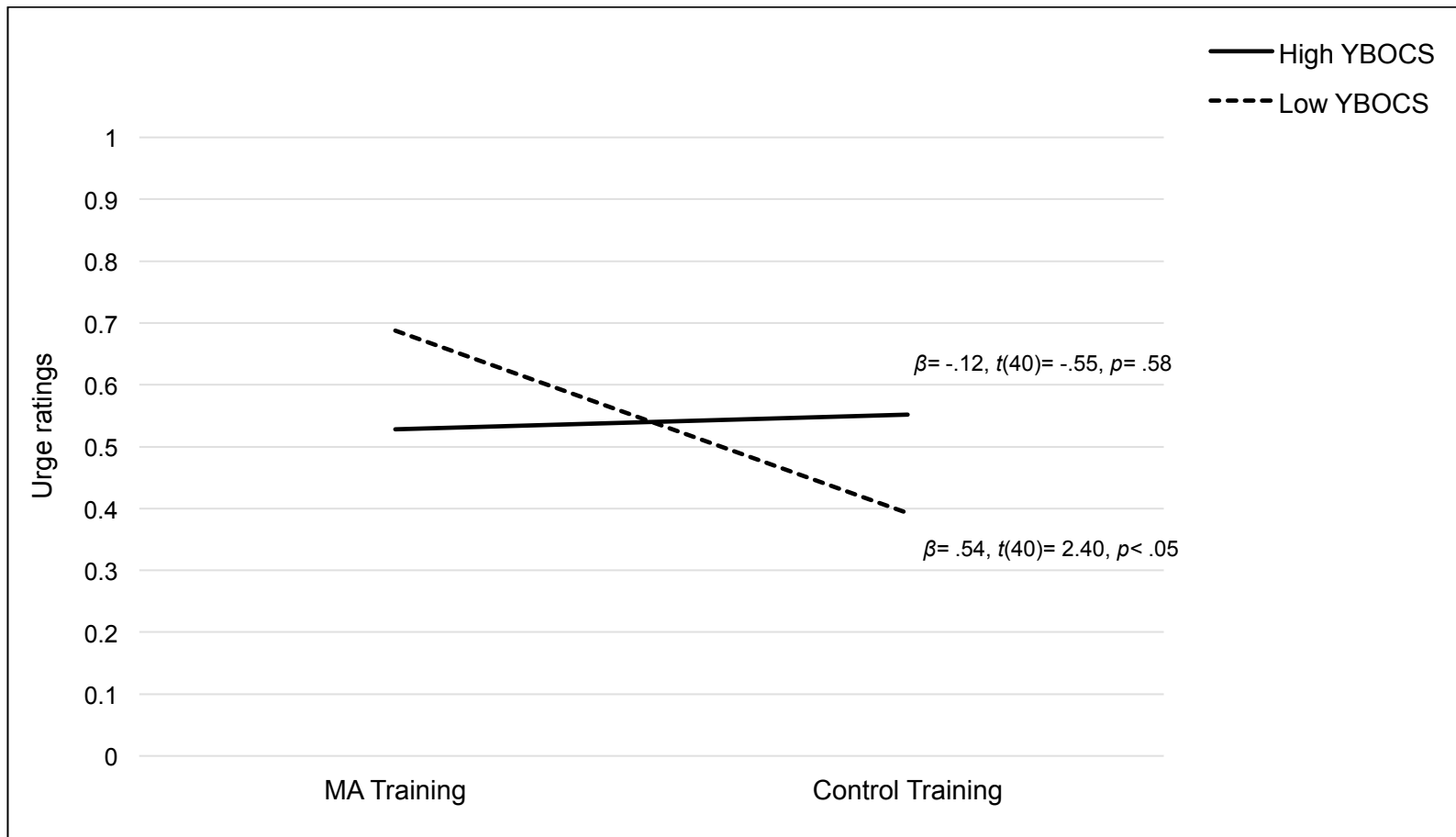
**Significant at the $p < .01$ level

Figure 6. Training condition and obsessive-compulsive symptom severity predicting aversiveness of contamination images



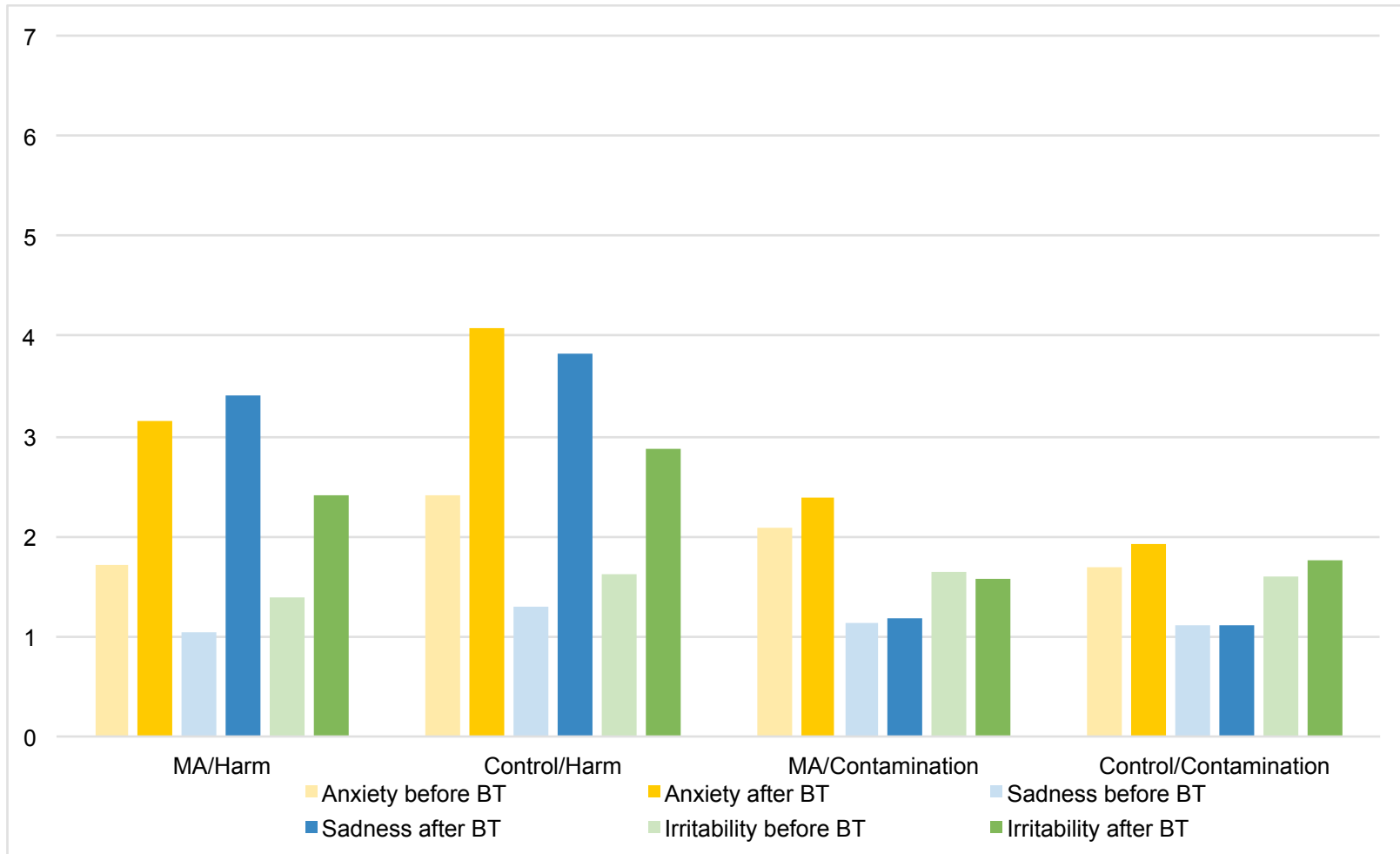
MA= Mindful Attention; YBOCS= Yale-Brown Obsessive Compulsive Inventory
 High and low YBOCS scores reflect 1 standard deviation above and below the YBOCS mean respectively

Figure 7. Training condition and obsessive-compulsive symptom severity predicting compulsive urges to contamination images



MA= Mindful Attention; YBOCS= Yale-Brown Obsessive Compulsive Inventory
High and low YBOCS scores reflect 1 standard deviation above and below the YBOCS mean respectively

Figure 8. Pre- to post-behavioral task (BT) changes in affect across the Mindful Attention (MA) and Control conditions



Tables

Table 1. Baseline sample characteristics

	Total Sample	MA/Harm	MA/Contamination	Control/Harm	Control/Contamination
N	97	25	23	24	25
<i>Sociodemographic variables</i>					
Age, mean (SD)	19.16 (1.46)	19.12 (.88)	19.35 (1.75)	18.79 (.78)	19.40 (2.04)
Sex, (% female)	57 (58.8%)	15 (26.3%)	14 (24.5%)	15 (26.3%)	13 (22.8%)
Race, White, N (%)	65 (67%)	18 (27.6%)	14 (21.5%)	16 (24.6%)	17 (26.1%)
Race, Asian, N (%)	16 (16.5%)	4 (25%)	4 (25%)	4 (25%)	4 (25%)
Race, Black, N (%)	9 (9.3%)	1 (11.1%)	2 (22.2%)	2 (22.2%)	4 (44.4%)
Ethnicity, non-Latino, N (%)	71 (73.2%)	19 (26.7%)	15 (21.1%)	21 (29.5%)	16 (22.5%)
<i>Mindfulness/Meditation experience</i>					
No experience, N (%)	71	14 (19.7%)	21 (29.5%)	17 (23.9%)	19 (26.7%)
Minimal experience, N (%)	18	8 (44.4%)	2 (11.1%)	4 (22.2%)	4 (22.2%)
Some experience, N (%)	8	3 (37.5%)	0 (0%)	3 (37.5%)	2 (25%)

Note. MA= Mindful Attention

Table 2. Psychiatric symptom profile of the sample

	Total Sample	MA/Harm	MA/Contamination	Control/Harm	Control/Contamination
N	97	25	23	24	25
<i>Psychiatric symptoms</i>					
OCIR total, mean (SD)	20.07 (12.80)	20.74 (13.38)	20.05 (11.63)	21.96 (15.28)	17.54 (10.69)
YBOCS total, mean (SD)	7.21 (5.70)	5.44 (5.10)	9.30 (5.20)	7.58 (5.99)	6.68 (6.08)
OBQ total, mean (SD) ⁺	144 (41.36)	129.08 (34)	151.04 (55.91)	167.42 (34.52)	132.68 (26.82)
DASS anxiety, mean (SD)	6.23 (6.60)	5.36 (6.45)	7.22 (5.99)	7.42 (8.86)	5.04 (4.48)
DASS depression, mean (SD)	5.81 (7.22)	5.44 (8.61)	5.83 (6.60)	6.92 (8.57)	5.12 (4.73)
<i>Psychiatric diagnoses</i>					
MDD, N (%)	25	7 (28%)	6 (24%)	7 (28%)	5 (20%)
SUD, N (%)	13	6 (46.2%)	2 (15.4%)	4 (30.8%)	1 (7.69%)
OCD, N (%)	12	1 (8.3)	4 (33.3%)	5 (41.6)	2 (16.6)
SAD, N (%)	7	1 (14.2%)	2 (28.5%)	3 (42.8%)	1 (14.2%)
GAD, N (%)	4	1 (25%)	1 (25%)	1 (25%)	1 (25%)

Note. MA= Mindful Attention; OCIR= Obsessive-Compulsive Inventory Revised; YBOCS= Yale-Brown Obsessive-Compulsive Scale; OBQ= Obsessive Beliefs Questionnaire; DASS= Depression, Anxiety, Stress Scales; MDD= Major Depressive Disorder; SUD= Substance Use Disorder; OCD= Obsessive Compulsive Disorder; SAD= Social Anxiety Disorder; GAD= Generalized Anxiety Disorder.

⁺Between-group differences were significantly different *only* for OBQ total.

Table 3. Means and standard deviations of dependent variables and moderator

	Total sample	MA/Harm	MA/Contamination	Control/Harm	Control/Contamination
N	97	25	23	24	25
Aversiveness, mean (SD)	47.12 (19.66)	42.40 (22.76)	51.25 (13.99)	48.41 (22.45)	46.24 (18.634)
Compulsive urge, proportion of yes/total (SD)	.44 (.34)	.35 (.33)	.59 (.33)	.36 (.32)	.47 (.35)
Distress, mean (SD)	37.91 (29.71)	24.08 (27.46)	50.09 (29.42)	37.64 (31.12)	40.24 (26.77)
Urge strength, mean (SD)	38.13 (32.90)	15.08 (25.26)	56.61 (29.09)	32.05 (29.10)	48.60 (32.55)
IED total shift errors, mean (SD)	10.84 (10.40)	10.67 (19.99)	12 (11.49)	11.19 (10.35)	9.63 (9.22)

Note. MA= Mindful Attention; IED total shift errors= Intra/Extradimensional task cognitive flexibility score.

Table 4. Pearson correlations among study variables

	YBOCS	Aversiveness	Compulsive Urge	Distress	Urge strength	Compulsion
Aversiveness	.13	-	-	-	-	-
Compulsive Urge	.05	.41**	-	-	-	-
Distress	.10	.35**	.10	-	-	-
Urge strength	.19	.33**	.26*	.50**	-	-
Compulsion	.27**	.31**	.09	.40**	.61**	-
IED total shift errors	-.07	.02	.00	.13	.04	.08

Note. YBOCS= Yale-Brown Obsessive-Compulsive Scale; Aversiveness= Aversiveness ratings of picture stimuli; Compulsive urge= Urge to complete compulsions in response to picture stimuli; Distress= Distress following the behavioral task; Urge strength= Urge strength following the behavioral task; Compulsion= Compulsive behavior following the behavioral task; IED total shift errors= Intra/Extradimensional task cognitive flexibility score.

Appendices

Appendix A. Obsessive Compulsive Inventory-Revised (Foa et al., 2002)

The following statements refer to experiences that many people have in their everyday lives. Circle the number that best describes **HOW MUCH** that experience has **DISTRESSED or BOTHERED you during the PAST MONTH**. The numbers refer to the following verbal labels:

0- Not at all 1- A little 2- Moderately 3-A lot 4- Extremely

1. I have saved up so many things that they get in the way.
2. I check things more often than necessary.
3. I get upset if objects are not arranged properly.
4. I feel compelled to count while I am doing things.
5. I find it difficult to touch an object when I know it has been touched by strangers or certain people.
6. *I find it difficult to control my own thoughts.*
7. I collect things I don't need.
8. I repeatedly check doors, windows, drawers, etc.
9. I get upset if others change the way I have arranged things.
10. I feel I have to repeat certain numbers.
11. I sometimes have to wash or clean myself simply because I feel contaminated.
12. *I am upset by unpleasant thoughts that come into my mind against my will.*
13. I avoid throwing things away because I am afraid I might need them later.
14. I repeatedly check gas and water taps and light switches after turning them off.
15. I need things to be arranged in a particular order.

16. I feel that there are good and bad numbers.

17. I wash my hands more often and longer than necessary.

18. I frequently get nasty thoughts and have difficulty in getting rid of them.

Italicized items comprise the obsessions subscale of the OCIR and were used to determine study eligibility.

Appendix B. Sample images used in the Picture Viewing Task

Harm symptom specific



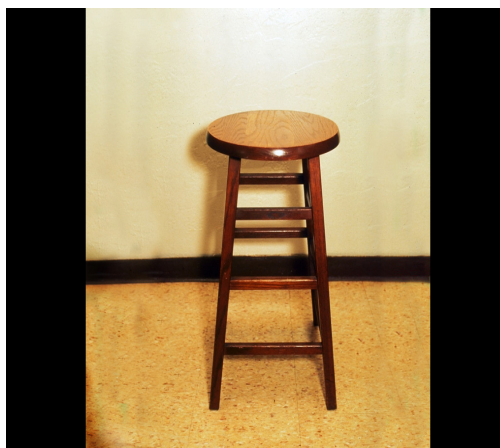
Harm neutral



Contamination symptom specific



Contamination neutral



Negative filler



Positive filler



Appendix C. Mindful Attention Training Instructions

(On computer screen): In this task, you will see a series of pictures, to which you may experience different types of reactions, such as thinking about what you could do with the object depicted in the picture, how it would feel to touch it, or any other thoughts such as liking or disliking the object.

People have different reactions to their surroundings. Your reactions are not caused just by the pictures, but rather what your mind happens to make of the pictures at that moment.

Please consider the nature of your thoughts and reactions to the pictures and imagine that thoughts are constructions of the mind, which appear and disappear. While viewing the pictures, observe your thoughts as transient states of the mind. Just observe your reactions, without suppressing or avoiding them. Imagine that your thoughts are nothing but passing mental events.

(Verbally stated by the experimenter): Some people think that these instructions are a little bit abstract or vague so let me explain with examples what the task is actually asking you to do.

We all have different types of thoughts and reactions to our experiences and things we see around us. Most of these thoughts just float in our consciousness and we may not notice whether we are responding to them or not. But, when we have a thought that is uncomfortable or distressing, we may want to distract ourselves or to suppress the thought to reduce the anxiety. What I'm asking you to do while you are viewing these pictures is to adopt a new way of relating to your thoughts that includes observing the thoughts without reacting to them.

During this task, just watch your thoughts appear and disappear in your stream of consciousness as if they are clouds that are drifting by. If you see something scary, you may think “I’m having the thought that this is scary” and let it go. If you see something dirty, you may think “I’m having the thought that is gross” and let that thought go. Does that make sense?

Appendix D. Control Training Instructions

(On computer screen): In this task, you will see a series of pictures, to which you may experience different types of reactions, such as thinking about what you could do with the object depicted in the picture, how it would feel to touch it, or any other thoughts such as liking or disliking the object.

People have different reactions to their surroundings. It is important that you try to relax while you view the pictures.

Just look at the pictures closely and in a very relaxed manner.

(Verbally stated by the experimenter): Some people think that these instructions are a little bit abstract or vague so let me explain with examples what the task is actually asking you to do.

We all have different types of thoughts and reactions to our experiences and things we see around us. Most of these thoughts just float in our consciousness and we may not notice whether we are responding to them or not. But, when we have a thought that is uncomfortable or distressing, we may want to distract ourselves or to suppress the thought to reduce the anxiety. What I'm asking you to do while you are viewing these pictures is to do nothing, except relax. Does that make sense?

Appendix E. Post Training Questions

Rated on a scale from 1(*not at all*) to 9 (*very much*)

Mindful Attention/Harm and Mindful Attention/Contamination

- 1) To what extent do you feel that you succeeded in observing your thoughts?
- 2) To what extent do you feel that you succeeded in perceiving your thoughts as mental events?

Control/Harm and Control/Contamination

- 1) To what extent do you feel that you succeeded in looking at the pictures closely?
- 2) To what extent do you feel that you succeeded in looking at the pictures in a relaxed manner?

Appendix F. Cognitive Interference Questionnaire

The following set of questions concerns the kinds of thoughts that go through people's heads during a task. Please indicate how often you had each thought during the Picture Viewing Task.

1 – Never 2 – Once 3 – A few times 4 – Often 5 – Very

Often

1. I thought about how I should work more carefully.
2. I thought about how much time I had left.
3. I thought about how others have done on the task.
4. I thought about the difficulty of the task.
5. I thought about my level of ability.
6. I thought about the purpose of the experiment.
7. I thought about how I would feel if I were told how I performed.
8. I thought about how often I get confused.
9. I thought about members of my family.
10. I thought about something that made me feel guilty.
11. I thought about personal worries.
12. I thought about something that made me feel angry.
13. I thought about something that happened earlier today.
14. I thought about something that happened to me days ago.
15. I thought about something that happened in the distant past.
16. I thought about something that might happen in the future.

Appendix G. Demographic and Mindfulness Experience Questionnaire

1. Age: _____
2. What is your year in school?
 - (1) Freshman
 - (2) Sophomore
 - (3) Junior
 - (4) Senior
3. What is your gender?
 - (0) Female
 - (1) Male
4. To which racial group do you most closely belong to?
 - (0) Caucasian/White
 - (1) African American/Black
 - (2) Asian or Pacific Islander
 - (3) American Indian
 - (4) Other (please specify): _____
5. To which ethnic group do you most closely belong to?
 - (0) NOT Hispanic or Latino
 - (1) Hispanic or Latino
6. What is your current overall GPA?
 - (0) 2.0 or less
 - (1) 2.1-2.5
 - (2) 2.6-3.0

(3) 3.1-3.5

(4) 3.6-4.0

7. What is your sexual orientation?

(0) Heterosexual

(1) Homosexual

(2) Bisexual

8. Have you ever received a psychiatric diagnosis?

(0) No

(1) Yes (please list): _____

9. Are you currently taking any medications?

(0) No

(1) Yes (please list): _____

10. Do you have a family history of OCD? (0) No (1) Yes

11. Do you have a family history of anxiety? (0) No (1) Yes

12. Do you have a family history of depression? (0) No (1) Yes

13. Have you ever had any experience with mindfulness or meditation?

(1) Never heard of it

(2) Heard of it 1-2 times

(3) Heard of it 4-5 times

(4) I'm an expert at mindfulness or meditation

14. Please provide details about the type and duration of your mindfulness/meditation

experience: _____

Appendix H. Debriefing

“You are done! Thank you so much for all your patience and cooperation! Please let us remind you that all your data is confidential. Results only include anonymous group data and your identifying information will not be linked to your answers on the surveys. The aim of this study is to examine how different ways of perceiving thoughts affect our cognitive and behavioral experiences. We ask you do not share the aims of the study with your peers. This is important for the researchers to obtain valid data. If you’d like a copy of the results, feel free to email us. If you have any questions or concerns about your participation in this study or would like to know the findings of the study, you can contact Demet Çek (demetcek@gmail.com; 305-284-2307) or Dr. Kiara Timpano (k.timpano@miami.edu; 305-284-1592). For any distress you may have experienced during the survey, please feel free to contact the University of Miami Counseling Center at 305-284-5511.”