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Manipulating mindful breathing versus mindful eating: examining the effect of specific mindfulness mechanisms on food intake and eating disorder symptoms.

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MANIPULATING MINDFUL BREATHING VERSUS MINDFUL EATING: EXAMINING THE EFFECT OF SPECIFIC MINDFULNESS MECHANISMS ON FOOD INTAKE AND EATING DISORDER SYMPTOMS

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DEDICATION

This dissertation is dedicated to every non-native English speaker in academia. You are brave, determined, and persistent, and you belong here. Never doubt yourself.

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I want to thank my mentor, Dr. Cheri Levinson, for pushing me to go further than I ever thought I could. I want to thank all my committee members for their wisdom, and especially Dr. Paul Salmon for introducing me to mindfulness. I am grateful to David Cheatham whose support allowed me the energy and time to focus on my studies and got me through the challenging times. I want to thank my labmate soon-to-be Dr. Leigh Brosof for her mentorship, kindness, and statistical lessons. Finally, I want to acknowledge my research assistants who helped collect data for this dissertation: Jordan Drake, Brenna Williams, Sarah Ernst, Lindsay Chapman, Breanna Walker, Madeline Nirmaier, and Emily Ryan.

ABSTRACT

MANIPULATING MINDFUL BREATHING VERSUS MINDFUL EATING: EXAMINING THE EFFECT OF SPECIFIC MINDFULNESS MECHANISMS ON FOOD INTAKE AND EATING DISORDER SYMPTOMS

Irina A. Vanzhula

August 10, 2021

Background. Understanding which specific mindfulness practices contribute to improvements in ED symptoms, as well as the mechanisms of action by which this change occurs, may help improve MBTs for EDs. The current study aims to compare the effects of various brief mindfulness exercises on state ED symptoms and food intake and to test whether a reduction in state rumination and state difficulties in emotion dysregulation and an increase in awareness of hunger, fullness, and satiety cues mediate these effects.

Methods. Two hundred and two undergraduate females participated in the experiment. Participants were randomized to listen to one of the four 15-minute audio recordings: Mindful eating, mindful breathing, mixed mindfulness (mindful eating and breathing), and control (a story about produce transportation). Next, participants were left alone with snacks (popcorn, apples, chocolate, and chips) for 10 minutes, and food intake was measured. Participants completed state surveys at three time points during the experiment.

Results. All four conditions led to a significant reduction of state ED symptoms short-term, but not two weeks later. Mindful breathing consistently had larger effects on most outcomes and resulted in both higher awareness of hunger, fullness, and satiety cues and greater high-density food intake compared to all other conditions. No indirect effects of the reduction in state rumination and state difficulties in emotion dysregulation and an increase in awareness of hunger, fullness, and satiety cues on state ED or food intake were found.

Conclusions. A variety of mindfulness and related practices (i.e., audio story) may be helpful in reducing ED cognitions and urges. Individuals with clinical or subclinical levels of ED may benefit most from practices combining both mindful eating and mindful breathing. Specifically, mindful breathing practice may result in higher congruency between hunger cues and food intake by increasing awareness of hunger, fullness, and satiety cues. More studies on mechanisms of action are needed.

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INTRODUCTION

Eating Disorders (EDs)

Eating Disorders (EDs) are serious mental illnesses with the second-highest mortality rate of all psychological disorders (Arcelus et al., 2011). EDs are characterized by maladaptive behaviors and cognitions, such as food restriction, binge eating, purging, excessive exercise, overvaluation of weight and shape, and fear of weight gain. The three primary ED diagnoses include anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED). The lifetime prevalence of EDs in the general population is estimated to be as high as 13% (Stice et al., 2017). EDs are extremely difficult to treat (Fairburn, 2008). Cognitive Behavioral Therapy for Eating Disorders (CBT-E) is currently the treatment of choice for individuals with BN and BED, but is effective only 50% of the time (Fairburn et al., 2009, 2015). Further, no empirically supported treatments exist for adults with AN. Even among individuals for whom treatment is effective, relapse rates for EDs are as high as 60% (Keel et al., 2005). Additionally, many individuals with EDs are resistant to seeking and engaging in treatment (Fairburn et al., 2009). It is evident that new and more effective and accepted treatments for EDs are urgently needed. One form of treatment that is gaining traction both outside of EDs and within the ED field is mindfulness.

Mindfulness

Mindfulness was introduced to the health field by John Kabat-Zinn, who defined mindfulness as “paying attention in a particular way: on purpose, in the present moment,

and nonjudgmentally" (Kabat-Zinn, 1990, p. 4). The main difference between mindfulness-based treatments (MBTs) and the traditional cognitive-behavioral approaches (Beck, 2011) is that instead of attempting to change the content of thoughts, the focus is placed on developing awareness and changing individual's relationship with thoughts. Through practice, mindfulness is theorized to lead to increased self-awareness, acceptance of thoughts and emotions, decreased emotional reactivity, and decreased maladaptive behaviors as responses to negative thoughts and emotions (Baer, 2006). Interventions that heavily utilize mindfulness meditation have received substantial empirical support for the treatment of depression and anxiety (Alsubaie et al., 2017; Chiesa & Serretti, 2011).

Regular practice of formal mindfulness meditation is thought to lead to adopting mindfulness in everyday life, or informal mindfulness (Bishop et al., 2006). *Formal mindfulness* involves intentionally setting aside time to practice cultivating awareness of the breath or other sensations. One example of formal mindfulness is breathing meditation. In breathing meditation, individuals are instructed to sit in a relaxed posture with their eyes closed and to direct attention to the sensations of breathing, as well as observe passing thoughts and emotions (Kabat-Zinn, 2013). *Informal mindfulness* refers to being present and aware during everyday activities, such as walking, eating, driving, doing dishes, etc. Practicing everyday mindfulness means bringing awareness and non-judgment to daily activities and being present while engaging in them (Teut et al., 2013). It is suggested that repeated formal practice leads to the adoption of mindfulness principles in everyday life (Hindman et al., 2015).

Mindfulness is a complex construct comprised of several aspects. The following mindfulness facets are commonly examined: *non-reactivity* (letting thoughts and feelings come and go without getting caught up in them), *acting with awareness* (attending to present moment activities), *observing* (noticing sensory experiences), *describing* (labeling experiences such as sensations or cognitions with words), *non-judgment* (refraining from an evaluation of thoughts and feelings), and *acceptance without judgment* (refraining from applying evaluative labels such as good/bad or right/wrong, and to allow reality to be as it is without attempts to avoid, escape, or change it; Baer et al., 2004; 2006). Other related constructs are *decentering* and *defusion* (a process of seeing thoughts or feelings as objective events in the mind; Hayes-Skelton & Graham, 2013). State and trait mindfulness are differentiated. *State mindfulness* refers to a temporary experience of being mindful, and *trait mindfulness* is a disposition to act mindfully across different situations (Kiken et al., 2015). During MBTs, repeated meditation practice cultivates greater state mindfulness over time, which eventually leads to the development of trait mindfulness (Kiken et al., 2015). It is suggested that repeated mindfulness practice leads to neurobiological changes that are associated with trait mindfulness (Holzel et al., 2011).

Mindfulness in the Treatment of EDs

MBTs for anxiety and depression, such as Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990) and Mindfulness-Based Cognitive Therapy (MBCT; Segal et al., 2002), have been adapted to treat BED by increasing focus on eating practices, such as mindful eating (Baer et al., 2005; Bankoff et al., 2012; Safer et al., 2001; Smith et al., 2006). Mindful eating involves eating slowly, without judgment or distraction, and

focusing on sensory qualities of the food, such as smell, look, and taste (Courbasson et al., 2010). One of the first MBTs specifically designed for BED was conducted in 1999 by Kristeller and Hallett (1999). Kristeller and Wolever (2010) developed Mindfulness-Based Eating Awareness Training (MB-EAT) for BED, incorporating MBCT and MBSR traditions but focusing primarily on emotions and cognitions associated with binge eating. Later, a variety of mindfulness-based groups for BED emerged that combined a wide range of mindfulness and acceptance-based techniques (i.e., informal mindfulness and metaphors; Courbasson et al., 2010; Duarte et al., 2017; Hepworth, 2010). Very little research exists on the effectiveness of MBTs for anorexia nervosa (AN) and bulimia nervosa (BN). Only two studies have included individuals with BN, and only one study has included participants with AN in addition to those with BED (Hepworth, 2010; Woolhouse et al., 2012).

MBTs for BED lead to a clinically significant reduction in binge eating episodes, binge eating symptoms (i.e., feeling a loss of control over eating), and overall ED symptoms, including weight and shape concerns, restriction, and body dissatisfaction in pre-post designs (e.g., Hepworth, 2010; Kristeller & Wolever, 2010; Woolhouse et al., 2012). Additionally, MBTs had a beneficial effect on other eating behaviors, such as dieting, emotional eating, external eating (eating triggered by being around food), and food craving. However, MBTs did not outperform treatment as usual in studies with wait-list and cognitive treatment control groups (e.g., Hepworth, 2010; Kristeller & Wolever, 2010; Woolhouse et al., 2012). Although there is growing evidence for MBTs for EDs, a recent systematic review of third-wave behavioral therapies for the treatment of EDs concluded that the MBTs currently do not meet the criteria for an empirically supported

treatment (Linardon et al., 2017). The majority of existing MBTs for EDs are a combination of mindfulness strategies borrowed or adapted from various MBTs for other psychological disorders. These treatments are constructed based on the theoretical rationale that mindfulness helps recognize hunger and satiety cues and improves emotion regulation (Baer et al., 2005). However, one limitation of these treatments is that they lack a strong theoretical foundation (i.e., an empirical justification for why a specific intervention is chosen for a specific symptom). Further, research on the mechanisms of action of MBTs for EDs is needed.

General Mindfulness vs. Mindful Eating in MBTs

Existing MBTs for EDs include a combination of both general mindfulness exercises (usually mindful breathing) and mindful eating practices (e.g., Hepworth, 2010; Kristeller & Wolever, 2010; Woolhouse et al., 2012). During a mindful eating exercise, participants examine the food item visually, smell it, notice how it feels in their mouth, and slowly chew while paying attention to textures and flavor changes (Courbasson et al., 2010). These practices are usually guided by a mindfulness practitioner in-person or by using an audio recording. Similar to mindful breathing practices, mindful eating encourages participants to observe thoughts and sensations that come up during the exercise. It is expected that by engaging in mindful eating exercises, participants learn a new mindful approach to eating, which translates to their everyday food consumption (Kristeller & Wolever, 2010). However, general mindfulness is thought to have a similar effect in a wider variety of daily activities, such as driving, doing dishes, showering, etc., and should generalize to eating (Hindman et al., 2015). To date, research has not compared the effects of relative contributions of each practice to the improvement of ED

symptoms. Therefore, it is unclear whether general mindfulness or mindful eating practices alone are enough to change ED symptoms and food intake, or if both are needed. Kristeller and Wolever (2010) considered general breathing meditation practice to be an essential component of MB-EAT for BED. However, general mindfulness practice may not be enough to affect change in ED symptoms. Without specific instruction, individuals may not think to apply the skills they learned from meditation practice to eating. Understanding how each practice may contribute to improvement in ED symptoms and food intake may help improve MBTs for EDs.

Several studies (described below) examined the effects of brief mindful eating and mindful breathing exercises on food intake separately. Food intake has been widely studied as an outcome of various experimental manipulations in the context of health behaviors (Rosenheck, 2008; Stok et al., 2016). Food intake is a correlate of disordered eating and can be viewed as a proxy for some disordered eating behaviors. For example, low food intake may be indicative of restriction and high food intake of overeating or binge eating (Agras & Telch, 1998; Jenkins & Tapper, 2014; Levinson & Rodebaugh, 2015). However, in most studies, lower food intake is considered preferable because it is "healthier" (Rosenheck, 2008). Additionally, some researchers have differentiated between the intake of "healthy" (i.e., carrots) and "unhealthy" (i.e., chips) foods (Marchiori & Papies, 2014). Studies testing the effect of brief general mindfulness and mindful eating on food intake are reviewed below.

General Mindfulness and Food Intake

In one experimental study, participants were assigned to a mindful attention condition (instructed to react to picture stimuli as transient mental events) or a control

condition (asked to simply observe pictures). After that, they were asked to look at pictures of attractive and neutral foods and move them closer or away based on the color of the frame (Papies et al., 2012). Participants in the mindful attention condition showed less impulsive responses to attractive food than those in the control condition, but food intake was not measured. Another study assigned participants to one of the two mindfulness conditions (thought defusion and acceptance of emotions) or control (relaxation) and asked them to use these techniques to avoid eating a bag of chocolates that was provided over the next five days (Jenkins & Tapper, 2014). The researchers found that participants in the thought defusion condition consumed significantly less chocolate and did not eat more chocolate when they came in for a five-day follow-up than individuals in the other two conditions (referred to as behavioral rebound; Jenkins & Tapper, 2014).

Marchiori and Papies (2014) compared the amount of food intake after doing a formal mindfulness practice (body scan) and listening to an audiobook. They found that in the control condition, but not in the mindfulness condition, hungry participants ate more chocolate cookies than those who were not hungry. However, when not controlling for hunger, the overall level of consumption did not differ based on the condition (Marchiori & Papies, 2014). A similar experiment was conducted by Dutt et al. (2019) comparing intake after doing a mindful breathing practice versus listening to an audiobook. Participants in the mindfulness condition consumed fewer chocolates than those in the control condition. Another study looked at the effect of mindful breathing exercise after exposure to food on subsequent food intake (Fisher et al., 2016). First, participants completed a food exposure task, in which they engaged in mindful observing

and touching the food, but they did not taste it. Afterward, they engaged in mindful breathing or reflected on their experience for ten minutes in the presence of the food. The researchers found that participants in the mindfulness group consumed fewer cookies than the controls, but they did not differ in the level of craving (Fisher et al., 2016).

Mindful Eating and Food Intake

In a correlational study, both trait mindfulness and a mindful approach to eating were individually associated with eating smaller portion sizes in the previous seven days. However, when both trait mindfulness and mindful eating were added into one model, only mindful eating was significantly associated with eating smaller portion sizes (Beshara et al., 2013). In an experiment conducted by Allirot et al. (2018), participants watched a video that instructed them on how to eat mindfully, and afterward, they were asked to taste finger foods using those instructions. Participants in the control condition watched a video about gastronomic sciences and received no instruction for tasting the food. Next, all participants were given access to an unlimited amount of the same foods for 15 minutes. Those in the mindful eating condition consumed less energy-dense foods and less food overall, but there was no difference in levels of hunger or liking the food (Allirot et al., 2018). Similar results were found by Mantzios et al. (2020) in an experiment comparing mindful eating, a mindful diary about chocolate, and control condition of reading a newspaper. The participants consumed less chocolate in both mindfulness conditions than in the control condition when left alone with food after the experimental manipulation. However, the self-reported desire to consume more chocolate did not differ across conditions (Mantzios et al., 2020). In another experiment, Mantzios et al. (2019) replicated these findings, while also reporting that state mindfulness

significantly increased in the mindful eating condition, but not in the control condition (reading a newspaper).

Arch et al. (2016) compared two forms of mindful eating (one using raisins and another chocolate) to distraction condition (eating while being distracted by a word puzzle), and a no-task condition. The researchers found that participants in both mindful eating conditions reported more enjoyment from food and an initial greater desire to continue tasting the food. However, these participants consumed less high-sugar and high-fat food compared to those in the distraction and no-task conditions when they were left alone with the food and instructed to eat as much as they wanted (Arch et al., 2016). Another experiment compared a brief mindful eating task (using M&M candy), a progressive muscle relaxation exercise, and a filler task (looking at patterns of letters on a computer screen; Donald & Atkins, 2016). The researchers found no difference between conditions in perceived stress, but the mindful condition led to less avoidant coping (i.e., coping by distracting) in those individuals who reported high stress levels (Donald & Atkins, 2016). Participants in the mindful eating and progressive muscle relaxation conditions had higher levels of state mindfulness than those in the control condition. Eating outcomes were not measured.

Summary

In conclusion, both general mindfulness and mindful eating practices resulted in reduced food intake. Additionally, general mindfulness exercises lessened impulsive reactions to food images and inhibited behavioral response to hunger. Mindful breathing exercises outperformed relaxation and guided imagery exercises in the reduction of high-calorie food intake. Similarly, mindful eating practices (using raisins and chocolate)

resulted in eating less calorie dense, high-sugar, and high-fat foods, and increased enjoyment of the food. Mindful eating practices outperformed various distraction tasks (i.e., word puzzle, a recording about food transportation), but not a food-focused mindful diary in the reduction of high-calorie food intake. Only two studies measured state mindfulness before and after experimental manipulations, finding that mindful eating practices and progressive muscle relaxation (but not other control conditions) increased state mindfulness. None of the reviewed studies measured disordered eating cognitions or behaviors. Instead, they focused on calorie count, consumption of "healthy" and "unhealthy" foods, and reducing overeating. Further, no studies compared general mindfulness and mindful eating conditions in the same experiment. Future research comparing the effect of various mindfulness practices on a wide range of eating-related outcomes (i.e., food intake, self-reported cognitions and urges) is needed.

Mechanisms of Change in MBTs for EDs

How Does Mindfulness Affect Change in ED Symptoms?

Another question regarding MBTs for EDs that has yet to be answered is, what are the mechanisms in MBTs that produce changes in ED symptoms and food intake? Mechanisms of change are defined as "the processes or events that are responsible for the change in therapy" (Kazdin, 2007, p. 3). Mechanisms are usually studied using mediational analyses, such as identifying whether a specific process, such as emotion regulation, mediates the relationship between treatment and outcome. Understanding the mechanisms of change can aid in designing effective treatment and in optimizing existing treatments by using only active components (Kazdin, 2007). For example, if emotion regulation is identified as a mechanism in MBTs, then mindfulness strategies that

specifically target this symptom should be included in treatment. Trait mindfulness is consistently identified as a mechanism of change in MBTs (Alsubaie et al., 2017; Gu et al., 2015; van der Velden et al., 2015) but the question of how changes in mindfulness affect ED symptoms is still left unanswered. It is likely that mindfulness leads to improvement in other constructs, such as rumination and emotion regulation, which then improves ED symptoms.

Mechanisms of Change in MBTs for Anxiety and Depression

Mechanisms of change of MBTs for psychological conditions other than EDs (i.e., anxiety, depression) have been extensively studied. Most studies have focused on MBCT and MBSR. MBSR was developed to treat chronic pain and has been used to relieve suffering in people with a variety of chronic health conditions (Kabat-Zinn, 2013). MBCT was developed to treat relapse in depression (Segal et al., 2002), but is also effective in relieving anxiety and stress in individuals with health problems (Alsubaie et al., 2017). Strong evidence emerged supporting increases in trait mindfulness and decreases in rumination (repetitive negative thinking about past events that focus on negative causes or consequences; Nolen-Hoeksema, 2000) as mechanisms of change in MBTs (Alsubaie et al., 2017; Gu et al., 2015; van der Velden et al., 2015). It has been long theorized that mindfulness reduces anxiety and depression through improving emotion regulation, and new studies now support this theory (Cheung & Ng, 2019). Considering the low levels of mindfulness and high levels of rumination and emotion dysregulation in individuals with EDs (Naumann et al., 2015), it is possible that these mechanisms may generalize to the treatment of EDs.

Theorized Mechanisms in MBTs for EDs

Research on mechanisms of change in MBTs for EDs is lacking. Studies on MBTs for BED theorize that mindfulness may be effective in reducing binge eating and overall ED symptoms primarily because it improves 1) emotion regulation, 2) distress tolerance, and 3) awareness of the physical sensation of hunger and satiety. Mindfulness improves emotion regulation by teaching an acceptance approach to emotions, which includes a willingness to experience emotions without judgment and reactivity (Baer et al., 2005). Further, mindfulness training helps individuals view emotions as transient and non-threatening events that can be tolerated (i.e., distress tolerance), which reduces the urge to avoid them by engaging in binge eating (Hepworth, 2010). Another common conceptual rationale for using MBTs for binge eating is related to physical sensations of hunger and satiety. It is hypothesized that long-term dieting and overeating lead to a loss of awareness of natural appetite cues, and individuals start relying more on external cues, such as the presence of food, boredom, emotional and social triggers (Lowe, 1993). Because individuals who binge eat, often eat past the point of moderate satiety, they learn to react only to extreme hunger and fullness, which maintains the binge eating cycle (Dicker & Craighead, 2004). Lack of sensitivity to hunger may make it easier to avoid eating for most of the day, leading to an intense feeling of hunger in the evening that triggers a binge eating episode. Then, disrupted satiety sensations make it easier to ignore sensations of fullness and eat to the point of discomfort. Mindfulness practices are hypothesized to help individuals to learn to recognize physiological cues of hunger and satiety and become less reactive to external triggers (Arch & Craske, 2006; Baer et al., 2005; Garland et al., 2017).

Although the MBTs focus primarily on the treatment of BED, there is a strong theoretical rationale for why similar mechanisms may affect change across all diagnostic groups, including AN and BN. The rationale for using mindfulness strategies for BED applies to BN, as binge eating is one of the core symptoms in BN. Individuals with BN, similarly to those with BED, show disrupted awareness of hunger and fullness cues (Kissileff et al., 1996), which can be improved by MBTs and lead to a reduction of binge eating. Similar to BED, BN is characterized by marked emotion dysregulation, and both binge eating and purging behaviors are conceptualized as attempts to escape from intolerable emotional states (Lavender et al., 2014). There is evidence that hunger and satiety cues are also disrupted in individuals with AN (Wierenga et al., 2015), and individuals with AN may benefit from re-learning to rely on these cues for food intake instead of rigid rules after weight restoration. Further, individuals with AN show poor awareness of their emotional states and difficulty identifying their feelings (i.e., alexithymia; Nowakowski et al., 2013), and restriction is sometimes conceptualized as an attempt to avoid negative emotional states (Corstorphine, 2006). Mindfulness may help individuals with EDs, regardless of diagnosis, to improve emotion regulation, increase tolerance of negative emotional states, and learn to eat intuitively by relying on hunger and satiety cues.

Overall, potential mechanisms of change in MBTs for EDs may include reduced rumination, improved emotion regulation, and increased awareness of hunger, fullness, and satiety cues. However, no theoretical model of how mindfulness may produce a change in EDs has been proposed. A recent systematic review concluded that across all types of MBTs for binge eating, study outcomes were consistent with hypothesized

mechanisms mentioned above, but lack of proper study designs and statistical analyses (i.e., mediation) makes it difficult to make any conclusions about mechanisms of action (Barney et al., 2019). In the following sections, I provide an overview of evidence for each of these three hypothesized mechanisms before proposing a model for mechanisms of action in MBTs for EDs.

Rumination as a Mechanism

Rumination is consistently identified as a mechanism of change in MBCT and MBSR for anxiety and depression (Alsubaie et al., 2017). Rumination is described as repetitive and passive negative thinking around a common theme of events or symptoms of distress (Nolen-Hoeksema, 2000). Brooding rumination (focusing on negative symptoms) is differentiated from reflective thinking, which refers to contemplating symptoms to better understand or eliminate them. Brooding rumination (referred to as just *rumination* in this text) has been established as a transdiagnostic risk factor for anxiety and depression (Michl et al., 2013). Mindfulness is theorized to help individuals disengage from reflexive rumination responses and bring their attention to the present moment (Teasdale, 2004). Several studies identified rumination, but not reflective thinking, as a mediator between treatment and psychological outcomes (i.e., Labelle et al., 2015; Shapiro et al., 2008; van Aalderen et al., 2012).

Rumination is a salient feature of ED psychopathology (Smith et al., 2018). Rumination is associated with higher ED symptoms in clinical (Naumann et al., 2015) and non-clinical populations (Nolen-Hoeksema et al., 2007; Rawal et al., 2010). Studies suggest that that rumination may be a risk factor for developing EDs and that there is a reciprocal relationship between rumination and ED symptoms (Holm-Denoma & Hankin,

2010; Svaldi & Naumann, 2014). In addition to experiencing high levels of general rumination, individuals with EDs engage in ED-specific rumination, such as rumination focused on food, weight control, and body shape (Rawal et al., 2010). Using longitudinal data from the ecological momentary assessment, Seidel et al. (2016) found that individuals with AN experience increased rumination about food and body-related content. Similarly, individuals with BED may dwell on their body size in comparison with desired appearance standards (Wang et al., 2017). A decrease in rumination about body shape and weight may improve one's self-worth and reduce body dissatisfaction (Svaldi & Naumann, 2014). Lower rumination about eating and food may reduce shame and anxiety associated with eating and lead to less compensatory behaviors and restriction.

Emotion Regulation as a Mechanism

Emotion regulation is a multifaceted construct with a heterogeneity of definitions. Broadly, emotion regulation refers to a variety of strategies that can be implemented at different times, from when emotions arise to when they are experienced and expressed (Goldin & Gross, 2010). Mindfulness may a) help build awareness and acceptance of emotions, b) let go of judgmental evaluations of emotions as good and bad, c) increase the ability to engage in valued action in the presence of distressing emotions (similar to psychological flexibility), d) inhibit impulsive behaviors (similar to non-reactivity facet), e) enhance the ability to tolerate emotions, and f) increase willingness to experience negative emotions as a part of life (Gratz & Tull, 2010). The latter is referred to as distress tolerance, which is a dimension of emotion regulation (Gratz & Roemer, 2004). Although there is a wealth of evidence that mindfulness meditation improves emotion

regulation (Chambers et al., 2009; Hölzel et al., 2011; Roemer et al., 2015), to my knowledge, no studies examined emotional regulation as a mediator of MBTs using longitudinal data. Cheung and Ng (2019) found that awareness and acceptance of negative emotions, lower impulse control difficulties, and improved emotion regulation mediated the relationship between trait mindfulness and anxiety and depression over six months. Another study found evidence to suggest that increased attentional control from mindfulness training leads to less reactivity, which in turn results in better emotion regulation via cognitive reappraisal (Garland et al., 2017). An experimental study found that participants who completed a short breathing exercise experienced significantly less negative affect viewing negative slides than those who were instructed to worry or focus their attention on nothing in particular (Arch & Craske, 2006). Neuroimaging studies show that mindfulness training reduces reactivity in brain regions responsible for an emotional response (Guendelman et al., 2017; Kral et al., 2018).

Emotion dysregulation is a core feature of EDs, and individuals with EDs report higher levels of emotion regulation difficulties compared to controls (Mallorquí-Bagué et al., 2018; Pisetsky et al., 2017). Additionally, the severity of eating pathology is associated with emotion regulation difficulties (Svaldi et al., 2012). The cognitive-behavioral model of EDs identifies mood intolerance (i.e., low distress tolerance) as one of the risk factors for developing an ED (Fairburn et al., 2003). Indeed, Lampard et al. (2011) found that individuals with EDs showed intolerance of both negative and positive affect. All EDs are sometimes conceptualized as disorders of emotion dysregulation, and binge eating, purging, and restricting are considered maladaptive and ineffective ways to regulate negative affect (Merwin, 2011). Treatments targeting emotion regulation

difficulties in EDs (i.e., dialectical behavioral therapy[DBT]) show good outcomes (Godfrey et al., 2015; Haynos et al., 2016). Reduced emotional reactivity to triggers and the ability to effectively regulate and tolerate emotions may reduce the need to engage in ED behaviors, such as binge eating, purging, restricting, excessive exercising, and body checking.

Awareness of Hunger, Fullness, and Satiety Cues as ED-Specific Mechanism

Increased awareness of physical sensations of hunger, fullness, and satiety cues is at the core of the theoretical rationale for using mindfulness in the treatment of EDs (Kristeller & Wolever, 2010), but, to my knowledge, it has not been examined as a potential mechanism of action. Physical hunger is a physiological sensation that feels like a gnawing, emptiness, or growling in the stomach. Physical hunger is the body's signal that it is low on energy and that blood sugar is too low. In contrast, psychological hunger is a desire to eat out of habit, because of the sight or smell of food, due to being emotional or upset, or because it tastes good. Fullness is a physiological sensation in the stomach that indicates the degree to which the space of the stomach is filled with food or liquid. Finally, satiety refers to both the physical and psychological state of feeling content and satisfied with the meal (Kristeller & Wolever, 2010). Some evidence exists that mindfulness meditation increases awareness of hunger and fullness cues beyond solely improving eating outcomes (Beshara et al., 2013; Hong et al., 2014; Kristeller et al., 2014).

Sensations of hunger and fullness, along with other bodily sensations such as heartbeat, body temperature, and pain, are part of interoceptive awareness, which has been more extensively studied. Interoceptive awareness is described as the processes of

perception and interpretation of internal signals relating to body states (Khalsa & Lapidus, 2016). Formal mindfulness practices (i.e., body scan) aim to bring attention to interoceptive sensations and increase body awareness. MBTs were shown to improve interoceptive awareness across a variety of physical and psychological conditions (Bornemann et al., 2015; Fischer et al., 2017; Fissler et al., 2016). Individuals with EDs have marked deficits in interoceptive awareness (Brown et al., 2017; Khalsa et al., 2015). One study found that interoceptive awareness, specifically, intolerance of emotional arousal, had an indirect effect on the relationship between mindfulness and ED symptoms above and beyond emotion dysregulation (Lattimore et al., 2017). Better awareness of physiological sensations of hunger and fullness may help individuals with EDs eat intuitively rather than relying on rules, urges, or external triggers and re-learn how to guide food intake based on the body's needs rather than dieting rules.

A Proposed Model of Mechanisms in MBTs for EDs

The theorized model of mechanisms by which MBTs improve ED symptoms is shown in Figure 1. I propose that mindfulness leads to reduced rumination, improved emotion regulation, and increased awareness of hunger, fullness, and satiety cues, which then reduce ED symptoms. First, a decrease in rumination about body shape and weight may increase one's self-worth and reduce body dissatisfaction. Second, reduced emotional reactivity to triggers and an ability to effectively regulate and tolerate emotions may reduce the need to engage in ED behaviors, such as binge eating, purging, restricting, excessive exercising, and body checking. Finally, interoceptive awareness of hunger and fullness cues may be an ED-specific mechanism that helps individuals with EDs regulate their eating based on the needs of their bodies. Future research should test if

this model fully or partially explains how MBTs may be helpful in treating EDs. This model is not exhaustive, and it is likely that other mechanisms, such as self-compassion, decentering, and psychological flexibility, may play a role. Please see Vanzhula and Levinson (2020) for a complete overview of the potential mechanisms of MBTs for EDs.

Current Study

Preliminary research suggests that MBTs show promise as potential new treatments for BED and possibly other EDs. However, MBTs fail to reach the status of an empirically supported treatment, and research on their efficacy is lacking. More research is needed to determine how to improve MBTs, and several questions are left to be answered. First, it is not clear whether the mindful eating practice is essential to an improvement in ED symptoms or if general mindfulness practice (i.e., mindful breathing) is sufficient to make a change. Currently, studies show that a combination of both leads to a reduction of ED symptoms (e.g., Courbasson et al., 2010; Kristeller et al., 2014), and brief interventions using each method separately lead to lower food intake (e.g., Arch et al., 2016; Marchiori & Papies, 2014). Additional research is needed comparing the effects of general mindfulness and mindful eating. Second, very little is known about how exactly mindfulness produces a change in ED symptoms and the mechanisms of change in MBTs for EDs. Answering these questions may help in designing effective, mindfulness-based interventions for EDs and fill a gap in the current lack of effective treatments for EDs. In the current study, I will a) examine if a mindful breathing audio exercise (general mindfulness), a mindful eating audio exercise (eating-focused mindfulness practice), a mixed audio exercise including both mindful breathing and mindful eating, and listening to a neutral audio-script describing transporting produce

from a farm to a store (control condition) differ in their effect on ED symptoms and food intake, and b) test whether emotion regulation, rumination, and awareness of hunger, fullness, and satiety cues mediate the effect of mindfulness on ED symptoms and food intake.

Study Hypotheses

Manipulation Check. Individuals in the Mindful Breathing, Mindful Eating, and Mixed-Mindfulness Conditions, but Not the Control Condition, Will Experience Elevated Levels of State Mindfulness

I will conduct a manipulation check to test if all three mindfulness conditions evoke state mindfulness. To do that, I will compare changes in state mindfulness before and after the audio exercise across the four conditions. I expect state mindfulness to be higher post audio exercise in mindful breathing, mindful eating, and mixed-mindfulness conditions compared to the control condition.

Primary Outcomes: State ED Symptoms and Food Intake

Hypothesis 1: Effect of Mindfulness Induction on State ED Symptoms

1.1 Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition, Will Lead to Lower State ED Symptoms. I will manipulate state mindfulness in the three conditions by having participants complete either a mindful breathing exercise, a mindful eating exercise, or a combination of mindful breathing and eating exercises. I expect that participants in all three mindfulness conditions will have lower state ED symptoms than those in the control condition at the end of the task. In the past research, MBTs with various combinations of mindful breathing and mindful eating exercises all resulted in reductions of ED symptoms (e.g., Alberts et al., 2012; Kristeller

et al., 2014). Both mindful breathing and mindful eating exercises cultivate mindfulness facets such as observing, awareness, and non-judgment, which are all associated with lower ED symptoms (Lavender et al., 2011).

1.2. The Mixed Mindfulness Condition Will Have a Larger Effect on State ED Symptoms Than Mindful Eating and Mindful Breathing Conditions. I hypothesize that post-manipulation state ED symptoms of the participants in the mixed-mindfulness condition will be significantly lower than state ED symptoms of the participants in the other two mindfulness conditions (mindful breathing and mindful eating) due to a combined effect of general mindfulness and mindful eating practices (Kristeller & Wolever; 2010).

1.3. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition, Will Lead to Lower Baseline ED Symptoms at a Two-Week Follow-up Compared to Baseline. I expect that the effect of the mindfulness exercises will persist short-term, and baseline ED symptoms (measured by a global score of the EDE-Q-6; Fairburn & Belgin, 1994) will be lower at a two-week follow-up compared to baseline. As with hypothesis 1.1, I predict that all three mindfulness conditions will outperform the control condition in reducing ED symptoms.

Hypothesis 2: Effect of Mindfulness Induction on Food Intake

2.1 Mindful Breathing, Mindful Eating, and Mixed Mindfulness Conditions Will Lead to a Lower Food Intake Compared to the Control Condition. I expect that participants in all three mindfulness conditions will consume less food than participants in the control condition, consistent with the previous literature (Allirot et al., 2018; Arch et al., 2016; Fisher et al., 2016; Jenkins & Tapper, 2014). Greater food intake can be

considered a proxy for overeating and binge eating, and such results would be consistent with the research on MBTs for the reduction of BED symptoms (Masuda & Hill, 2013; Wanden-Berghe et al., 2010). I will also test if the intake of types of food (i.e., "healthy" vs. "unhealthy") is different across conditions. To be consistent with the non-judgment premise of mindfulness, I will refrain from using evaluative language to describe food, such as "healthy" or "unhealthy." Instead, I will refer to "healthy" food as low-density food, and to "unhealthy" food as high-density food. Consistent with previous research (Jordan et al., 2014), I expect that individuals in all mindfulness conditions will consume less high-density foods (chocolate and chips) than in the control condition. However, there will be no difference in the consumption of low-density foods (apples, popcorn) across conditions.

2.2. The Mixed Mindfulness Condition Will Have a Larger Effect on Total Food Intake Than the Mindful Eating and Mindful Breathing Conditions. I hypothesize that the food intake of the participants in the mixed-mindfulness condition will be significantly lower than the food intake of the participants in the other two mindfulness conditions (mindful breathing and mindful eating) due to a combined effect of general mindfulness and mindful eating practices (Kristeller & Wolever, 2010).

The Role of Trait Mindfulness and Baseline ED Symptoms

Hypothesis 3: Trait Mindfulness and Experimental Conditions Will Interact in Their Effect on State ED Symptoms and Total Food Intake

Specifically, I expect that those high in trait mindfulness will have lower ED symptoms after participating in the mindful breathing, mindful eating, and mixed-mindfulness exercises compared to those low in trait mindfulness. This moderation effect

may be due to a cumulative nature of mindfulness practices, with increased benefits for long-term meditation practice (Lykins & Baer, 2009).

Hypothesis 4: Baseline ED Symptom Severity and the Experimental Conditions Will Interact in Their Effect on State ED Symptoms and Total Food Intake

Specifically, I predict that individuals with higher ED symptoms at baseline will benefit less from mindfulness induction than those with lower ED symptoms. Prior research shows that mindfulness is negatively associated with ED symptoms, and individuals with EDs have lower levels of mindfulness than those without EDs (Adams et al., 2012; Butryn et al., 2013; Compare et al., 2012). Additionally, some evidence suggests that individuals with EDs may experience increased distress during mindfulness exercises (Cowdrey & Park, 2012). Considering these findings, it is possible that individuals with high baseline ED symptoms may have some difficulty engaging in mindfulness exercises. As a result of these difficulties, they may receive less benefit from the mindfulness exercises than those with low ED symptoms.

Secondary Outcomes

Hypothesis 5. Effect of Mindfulness Induction on State Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues.

5.1. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition Will Lead to Reduced State Rumination. Considering there is a large body of evidence showing that mindfulness reduces rumination (Alsubaie et al., 2017), I predict that all three mindfulness conditions, but not the control condition, will significantly lower state rumination post-manipulation.

5.2. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition Will Lead to Reduced State Difficulties in Emotion Regulation. Prior research suggests that mindfulness helps build awareness and acceptance of emotions, inhibits impulsive behaviors, and enhances the ability to tolerate negative emotions (Garland et al., 2017; Gratz & Tull, 2010; Goldin & Gross, 2010). Therefore, I predict that all three mindfulness conditions, but not the control condition, will lead to reduced difficulties in emotion regulation post-manipulation.

5.3. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition Will Lead to Increased State Awareness of Hunger, Fullness, and Satiety Cues. Mindfulness meditation and mindful eating exercises increase awareness of body sensations that are associated with hunger and fullness (Kristeller & Wolever, 2010). Thus, I predict that all three mindfulness conditions, but not the control condition, will lead to increased state awareness of hunger, fullness, and satiety cues post-manipulation.

Hypothesis 6: Mediation Analyses

6.1. Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues Will Mediate the Effect of the Mindfulness Induction on the Reduction of State ED Symptoms. I predict that rumination, difficulties in emotion regulation, and awareness of hunger, fullness, and satiety cues will at least partially mediate the relationship between mindfulness induction (mindful breathing, mindful eating, and mixed mindfulness) and state ED symptoms. Rumination has been identified as a mediator of MBTs for other conditions in previous research (Alsubaie et al., 2017; Gu et al., 2015; van der Velden et al., 2015), and because of the

significant role rumination plays in maintaining EDs (Naumann et al., 2015; Seidel et al., 2016; Startup et al., 2013), its mediational effects are likely to generalize. There is strong evidence that mindfulness improves emotion regulation (e.g., Arch & Craske, 2006; Garland et al., 2017), and many ED behaviors are conceptualized as ways to regulate emotions (Baer et al., 2005; Lavender et al., 2014). Therefore, it is likely that mindfulness would increase emotion regulation, which would then reduce the need to engage in ED behaviors. Finally, mindfulness improves interoceptive awareness (Bornemann et al., 2015; Carmody & Baer, 2008; Fischer et al., 2017), which may improve awareness of hunger, fullness, and satiety signals in individuals with EDs, reducing overeating and binge eating.

6.2. Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues Will Mediate the Effect of Mindfulness Induction on Lower Food Intake. I predict that rumination, difficulties in emotion regulation, and awareness of hunger, fullness, and satiety cues will at least partially mediate the relationship between mindfulness induction (mindful breathing, mindful eating, and mixed mindfulness) on food intake.

METHODS

Power

In previous experimental studies that manipulated state mindfulness and examined eating behavior outcomes, effect sizes ranged from small (η^2=.04-.09) to relatively large (η^2=.14-.34; Allirot et al., 2018; Hartmann et al., 2015; Marchiori & Papies, 2014). A power analysis was conducted using G*Power version 3.1 (Faul et al., 2009). Using the estimates from previous literature for the most conservative effect size (.04) for power at .80, I would need 159 participants. Because general mindfulness and mindful eating have not been previously compared, I used the most conservative estimate of 159 participants intending to recruit at least 164 participants (~41 per condition).

Participants

Participants were 202 women recruited from undergraduate psychology classes at the University of Louisville. Participants were all female because disordered eating is highly prevalent in women, more so than in men (Hudson et al., 2007). An all-woman sample provides relatively greater power than a sample that includes both sexes because there is a broader range of eating behaviors and a higher prevalence of disordered eating in women. In a sample of both men and women, sex difference tests would be crucial. To appropriately power tests of gender would require at least twice as many participants, which would not be feasible. See the Results section for a detailed description of the study participants.

Procedure

For an overview of the study procedures, see Figure 2. Participants were recruited from the undergraduate subject pool to participate in the "Physiological sensations and attention study." The study was advertised to collect physiological data, such as heart rate and accelerometer data, during an attention task and there was no mention of food or eating behaviors. The wall signs with the name of the research laboratory were covered up during the experiment to avoid any clues that the study was measuring eating behaviors. Participants signed up to participate through the SONA system and received up to two and a half credit hours for their participation or extra class credit as determined by the class instructor. Participants signed up for a time slot to come into the lab for two hours between the hours of eight am and four pm. The time of the experiment was collected. Participants were asked to eat normally the day before the experiment and to not eat for two hours before their participation. When participants came in, the experimenter explained the consent form and had participants sign the consent. Next, participants were asked to complete several questionnaires on the computer, which took approximately 30-40 min. Participants' hunger level was measured, and the time of day of the experiment was recorded. Participants wore Empatica E4 wristbands that measured physiological activity, such as heart rate variability and body temperature, for the entire length of the experiment. These data were not analyzed in the context of the current study.

Next, participants were randomly assigned to one of four conditions: a mindful eating exercise (condition 1), a mindful breathing exercise (condition 2), a mixed mindfulness exercise (a combination of mindful eating and breathing exercises; condition

3), or a control condition (a story about transporting produce from a farm to a store; condition 4). There were two versions of the mixed mindfulness condition recording to counterbalance the order effect. First, participants completed a short state questionnaire (approximately 5 minutes long) assessing their current thoughts regarding eating and their weight and shape, hunger and fullness, rumination, and emotion regulation. Next, participants listened to one of the five recordings instructing them to engage in one of the mindfulness exercises or to passively listen to a story about transporting produce from a farm to a store (condition 4). In the first version, mindful breathing was followed by mindful eating, and in the second version, mindful eating was followed by mindful breathing. Each recording was 15 minutes long. Then, participants repeated the state questionnaires. After the questionnaires have been completed, participants were told that "the experimenter is preparing the last step of the study which may take a while," and that they should feel free to help themselves to snacks in the meantime. Participants were left in a room with a bowl of Lay's plain potato chips, a bowl of Hershey's Kisses chocolate pieces, a bowl of apple slices, a bowl of Skinny Pop plain popcorn, and a bottle of water for 10 minutes. Each bowl and the water bottle were weighed with the Etekcity electronic food scale before and after they were left in the room with the participant to measure ounces of food consumed. The experimenter then returned and measured the participants' weight. Participants completed the state questionnaires one more time. Two weeks after the in-lab session, participants were sent a series of online questionnaires about personality, psychological symptoms, and behavior. These questionnaires took approximately 20 minutes to complete. The survey included a

debriefing form at the end, including psychological resources and the principal investigator's contact information.

Experimental Conditions

Participants assigned to the first condition participated in a 15-minute mindful eating exercise. They were provided with three raisins on a napkin, and they listened to an audio recording guiding them through the exercise. The script for the mindful eating exercise has been adapted from the raisin exercises in the MBCT program by Segal et al. (2002) and the MB-EAT program by Kristeller and Wolever (2010). Participants assigned to the second condition participated in a 15-minute mindful breathing exercise. The script has been adapted from the Mindfulness of the Breath exercise by Segal et al. (2002). Participants in the third condition participated in a 15-minute mixed mindfulness breathing and eating exercise. The scripts from conditions one and two were shortened to seven and a half minutes each to create this mixed mindfulness condition. I created two versions of condition three (mindful eating, followed by mindful breathing and vice versa) to control for order effects. The script for the control condition was developed for this study. Previous studies utilized an audiobook recording, newspaper text, or a guided imagery exercise (e.g., visualizing waking through a garden) as a control condition (Fischer et al., 2016; Mantzios et al., 2019; Marchiori & Papies, 2013). Experiments with a mindful eating condition have also used a video about gastronomic sciences and an audio recording about the use of boxes in produce transportation (Allirot et al., 2018; Hong et al., 2011). A proper control condition to compare to the mindful eating exercise would include a neutral food-related script because we need to control for participants listening to the material about food. Therefore, a script about how produce is

transported from a farm to a grocery store was created. While listening to the audio in the control condition, participants were instructed to "let their mind wander" and "think of whatever comes to mind." All five scripts are available in Appendix 1.

Self-Report Measures

Demographics

Participants filled out a demographic form with the following information: age, sex, ethnicity, religious affiliation, and level in school.

Attention Check

A checklist was created to assess whether participants were paying attention to the recording. The survey asks participants to select all items that describe the recording they just heard. The answer options included: *1) Eating a raising, 2) watching the breath, 3) paying attention to thoughts, 4) transportation of produce, 5) looking at a raisin, 6) farming fruits and vegetables, and 7) paying attention to breathing.* For the mindful eating condition, the correct answer choices are 1 and 5. Choices 2, 3, and 7 are acceptable, and 4 and 6 are incorrect. For the mindful breathing condition, answers 2, 3, and 7 are correct, and the rest are incorrect. For the mixed mindfulness condition, answers 1, 2, 3, 5, and 7 are correct; 4 and 6 are incorrect. For the control condition, answers 4 and 6 are correct, and the rest are incorrect. A participant was considered to have passed the attention check if they selected at least one correct answer and no more than one incorrect answer. Participants who failed the attention check were removed from analyses.

"Bogus" Questionnaire

The "bogus" questionnaire (Meade & Craig, 2012) included five items that intended to elicit nearly identical responses from most participants to check for inattentive responding. The items were interspersed throughout the two-week follow-up survey: *1)I do not understand a word of English* (correct answers are *strongly disagree* or *disagree*), 2) *I am enrolled in a Psychology course currently* (correct answers are *strongly agree* or *agree*), 3) *If you are reading this, answer 2* (the correct answer is 2), *4) All my friends are aliens* (correct answers are *strongly disagree* or *disagree*), and 5) *If you are reading this, answer option 4* (the correct answer is 4). Participants were excluded if they incorrectly answered more than one "bogus" question.

The Five Facet Mindfulness Questionnaire (FFMQ)

The FFMQ (Baer et al., 2006) is a 39-item measure used to assess the multifaceted construct of mindfulness. It contains five subscales: Observe (e.g., *When I'm walking, I deliberately notice the sensations of my body moving*), Describe (e.g., *I'm good at finding words to describe my feelings*), Acting with Awareness (e.g., *When I do things, my mind wanders off* and *I'm easily distracted*), Nonreactivity (e.g., *I perceive my feelings and emotions without having to react to them*), and Nonjudging (e.g., *I criticize myself for having irrational or inappropriate emotions*). Scores for the FFMQ subscales are calculated by summing individual items for each subscale, and the overall mindfulness score is calculated by summing all of the subscales. The total FFMQ score was used in the analyses because I was interested in measuring participants' overall multidimensional trait mindfulness. Higher scores indicate higher trait mindfulness. The FFMQ has been shown to have good temporal consistency, acceptable reliability

coefficients, and satisfactory discriminant validity (Baer et al., 2006). In the current study, the internal consistency was good (α = .86).

Eating Disorder Examination Questionnaire Version 6.0 (EDE-Q-6)

The EDE-Q-6 (Fairburn & Belgin, 1994) is a 28-item self-report questionnaire that is designed to assess ED behaviors and thoughts. This version has four subscales: Eating Concerns (e.g., *Have you had a definite fear of losing control over eating*?), Shape Concerns (e.g., *Has your shape influenced how you think about (judge) yourself as a person*?), Weight Concerns (e.g., *Has your weight influenced how you think about (judge) yourself as a person*?), and Restraint (e.g., *Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight, whether or not you have succeeded*?). The global score of the EDE-Q-6 can be calculated by summing the subscale totals and dividing by the number of subscales to measure overall eating symptomatology. EDE-Q-6 was used to assess baseline ED symptoms at baseline and follow-up. Higher scores indicate higher ED symptoms. The EDE-Q-6 has demonstrated excellent test-retest reliability and good internal consistency (Luce & Crowther, 1999) and acceptable to good criterion validity and concurrent validity (Mond et al., 2004). In the current study, the internal consistency for the global score was excellent (α = .95).

State Eating Disorder Symptom Survey (SEDS)

A measure of ED thoughts and urges have been created for this study based on the items from EDE-Q-6 (Fairburn & Belgin, 1994), because, to my knowledge, no state ED measure exists in the literature. The measure contains 30 items and asks participants to report how they are feeling right now (e.g., *I am currently feeling fat*; *I want to binge*). The answer options are measured on a seven-point Likert scale from 0 (not at all) to 6

(very much so). The total score on the measure is obtained by summing up all the item scores and dividing the total by the number of items. The SEDS was used to assess the change in state ED symptoms during the experiment. Higher scores on SEDS indicate higher ED symptoms. See Appendix 2 for a full description of this measure. In the current study, the internal consistency of the total score was excellent (α = .96). The total score was very highly correlated with baseline ED symptoms (r = .81, p < .001), moderately negatively correlated with trait mindfulness (r = -.32, p < .001), and moderately positively correlated with state difficulties in emotion regulation (r = .31, p < .001) and state rumination (r = .30, p < .001), indicating good convergent and divergent validity.

State Mindfulness Scale (SMS)

State mindfulness was measured by the State Mindfulness Scale (SMS; Tanay and Bernstein, 2013). The SMS is a self-report measure that consists of 21 items an uses a five-point Likert response scale from 1 (not at all) to 5 (very well). The measure assesses state mindfulness immediately following a mindfulness experience. The SMS has two subscales: Mindfulness of Mind (e.g., *I was aware of what was going on in my mind*) and Mindfulness of Body (e.g., *I noticed physical sensations come and go*). The scores for each subscale are calculated by adding scores for each item in that subscale, and the total score is calculated by summing the two subscales. The SMS was used to assess state mindfulness before and after the mindfulness induction and to check experimental manipulation. Higher scores on SMS indicate higher state mindfulness. The SMS has excellent reliability and good internal consistency and construct validity (Tanay

and Bernstein, 2013). In the current study, the internal consistency was excellent (α = .92).

State Difficulties in Emotion Regulation Scale (S-DERS)

The State Difficulties in Emotion Regulation Scale (S-DERS) is a state version of trait-based DERS (Lavender et al., 2017). The S-DERS is a 21-item questionnaire designed to assess state-based emotion regulation difficulties. The measure is comprised of four subscales including Nonacceptance of Emotions (e.g., *I feel guilty for feeling this way*), Impulse Control Difficulties (e.g., *I feel out of control*), Lack of Awareness of Emotions (e.g., *I am paying attention to how I feel*), and Lack of Emotional Clarity (e.g., *I have no idea how I am feeling*). Scores for the S-DERS subscales are calculated by summing individual items for each subscale, and the S-DERS total score is calculated by summing all 21 items. The total S-DERS was used to measure state difficulties in emotion regulation during the experiment. Higher scores on S-DERS indicate more difficulties with emotion regulation. The measure has good internal consistency, construct, predictive, and discriminant validity (Lavender et al., 2017). In the current study, the internal consistency was good (α = .90).

Repetitive Thinking Questionnaire – State (RTQ-S)

The original RTQ (McEvoy et al., 2010) was designed to assess trait rumination and worry. The short version of the RTQ (McEvoy et al., 2017) contains 10 items from the original Repetitive Negative Thinking Factor. For this study, the items were adapted and modified from the RTQ-10 scale to assess ruminative thoughts in a momentary fashion. For example, item *You have thoughts or images that are difficult to forget* was changed to *I can't forget thoughts or images about that situation*. The total score is

calculated by summing all 10 items of the RTQ-S. The RTQ-S state was used to measure the level of state rumination during the experiment. Higher scores on the RTQ-S state indicate higher state rumination. The RTQ-10 has excellent internal validity, a high level of predictive utility, and internal reliability and is significantly associated with measures of anger, shame, distress, and anxiety (McEvoy et al., 2010). In the current study, the internal consistency of the RTQ-S was excellent (α = .96). See Appendix 2 for a full description of this measure.

Hunger Measure

Hunger was measured with one item that assesses the current hunger level on a seven-point Likert scale ranging from 1 = not at all to 7 = extremely as used in Oliver et al. (2000).

History of Mindfulness Practice

Two items were developed for this study to access participant's experience with practicing mindfulness (*Have you ever practiced mindfulness meditation?* and *Please indicate how long you have been practicing mindfulness meditation in months*. If participants answered "*No*" to the first question, the second question was coded as zero for the analysis.

Eating Awareness Scale – State (EAT-S)

A measure that assesses awareness of hunger, fullness, and satiety cues was developed for this study because, to my knowledge, no such measure exists in the literature. The measure describes four concepts (physical and psychological hunger, stomach fullness, and satiety) according to the definitions introduced by Kristeller and Wolever (2010). First, each concept is defined and then participants are asked to rate their

level of hunger, fullness, and satiety on a 1-10 scale (e.g., *Please mark how full your stomach is right now on a scale of 1-10, 1 being not full at all and 10 being the most full*). Next, participants are asked how well they believe they can identify the level of hunger, fullness, and satiety (e.g., *I can accurately identify how physically hungry I am right now*), and whether they can identify the sensations associated with each state (e.g., *I can identify whether I am feeling the sensations of fullness in my stomach*). The total score is calculated by summing items 2, 3, 5, 6, 8, 9, and 11. The EAT-S was used to measure state awareness of hunger, fullness, and satiety during the experiment. Higher scores indicate higher awareness. In the current study, the internal consistency was excellent (α = .91). The scale was significantly positively correlated with trait (r = .20, p = .013) and state (r = .19, p = .024) mindfulness and significantly negatively correlated with state ED symptoms (r = -.18, p = .024) and state difficulties in emotion regulation (r = -.34, p < .001), suggesting acceptable convergent and divergent validity. See Appendix 2 for a full description of this measure.

Food Measure

Bowls of Lay's plain potato chips, Hershey's Kisses chocolate pieces, apple slices, and Skinny Pop plain popcorn were weighed with the Etekcity electronic food scale before and after participants were given the opportunity to snack from each bowl. Four variables of each food consumed in ounces were created. The food items were modified from Wallis & Hetherington (2009) to account for possible gluten allergies and include chocolate, a commonly used food in mindful eating studies (Allirot et al., 2018; Jenkins & Tapper, 2014).

Food Allergy

Participants were asked if they were allergic to any food with *Yes* and *No* response options. If *Yes* was selected, participants were asked to list the foods they were allergic to. The responses were coded for the individuals who were allergic to any of the foods provided during the experiment.

Body Measures

Body weight was measured at the end of the session using an Omron HBF-400 scale (Omron Health Care Inc, 2009). The experimenter asked the participants their height during the study. Weight and self-reported height were used to calculate BMI.

Data Analyses

Manipulation Check

A mixed two-way ANOVA in SPSS v. 26 was used to compare whether levels of state mindfulness increased after the audio exercise across the four experimental conditions. The experimental condition was entered as an independent variable (IV) with four factors, and state mindfulness was the dependent variable (DV) with two factors (i.e., two time points). Pairwise differences were examined to compare the differences across conditions.

Effect of Mindfulness Induction on State ED Symptoms

A mixed two-way ANOVA in SPSS v.26 was used to test the effect of condition (mindful breathing, mindful eating, mixed mindfulness, or control) on ED symptoms. The experimental condition was entered as an IV with four factors (conditions), and the baseline ED symptoms variable was the DV with three factors (i.e., three time points). Pairwise comparisons were used to test the differences across conditions and time points.

Effect of Mindfulness Induction on Food Intake

A one-way ANOVA in SPSS v. 26 was used to compare food intake across four experimental conditions (mindful breathing, mindful eating, mixed mindfulness, or control). The experimental condition was entered as the IV with four factors (conditions). In the first model, total food intake was entered as a DV. In the second model, the low-density food total was entered as a DV. In the third model, the high-density food total was entered as a DV. Pairwise comparisons were used to test the differences across conditions.

Moderation Analyses

Multiple regression analysis was conducted in SPSS v. 26. The experimental conditions were dummy coded into three variables for use in the multiple regression: Variable 1 (mindful eating = 1; mindful breathing, mixed mindfulness, and control = 0), Variable 2 (mindful breathing = 1; mindful eating, mixed mindfulness, and control = 0), and Variable 3 (mixed mindfulness = 1; mindful eating, mindful breathing, and control = 0). In the first two models, the dummy-coded experimental conditions were entered as the three categorical IVs, and baseline trait mindfulness was entered as the fourth continuous IV. Three interaction terms between each dummy-coded condition variable and trait mindfulness were also entered as IVs. In the first model, the change score of state ED symptoms from time 1 to time 2 was entered as a DV. In the second model, total food intake was entered as a DV. In the third and fourth models, the dummy-coded experimental conditions were entered as the three categorical IVs, and baseline ED symptoms variable was entered as the fourth continuous IV. Three interaction terms between each dummy-coded condition variable and baseline ED symptoms were also entered as IVs. In the third model, the change score of state ED symptoms from time 1 to

time 2 was entered as a DV. In the fourth model, the total food intake was entered as a DV.

Effect of Mindfulness Induction on State Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues (i.e., Eating Awareness)

A mixed two-way ANOVA in SPSS v.26 was used to test the effect of condition (mindful breathing, mindful eating, mixed mindfulness, or control) on state rumination, difficulties in emotion regulation, and awareness of hunger, fullness, and satiety cues. In all models, the experimental condition was entered as an IV with four factors (conditions). In the first model, state rumination was entered as a DV with three factors (i.e., three time points). In the second model, state difficulties in emotion regulation variable was entered as a DV with three factors (i.e., three time points). In the third model, state awareness of hunger, fullness, and satiety cues was entered as a DV with three factors (i.e., three time points). Pairwise comparisons were used to test the differences across conditions.

Mediation Analyses

Mediational analyses were conducted using structural equation modeling (SEM) in Mplus testing for indirect effects (Muthen, 2011). First, model fit was evaluated using the (a) comparative fit index (CFI; Bentler, 1990), (b) Tucker-Lewis incremental fit index (TLI; Tucker & Lewis, 1973), (c) root-mean-square error of approximation (RMSEA; Steiger & Lind, 1980), and (d) standardized rootmean-square residual (SRMR; Bentler, 1990). The magnitudes of these indices were evaluated with the aid of recommendations by Hu and Bentler (1999). Specifically, for the CFI and TLI, values of .90 and above are

considered adequate, whereas values of .95 or above are considered very good; for the RMSEA and SRMR, values of .08 and below are considered adequate, and values of .05 or less are considered very good.

RESULTS

Available Data

Participants were included in the analyses if they completed the experiment, passed the attention check for the audio exercise (described above in Methods), and were not flagged as inattentive responders. Inattentive responding refers to participants responding to a self-report measure without paying attention to the content of the question (Maniaci & Rogge, 2014). Prior studies identified rates of inattentive responding in undergraduate samples as 10-12% (Meade & Craig, 2012). In this study, participants were considered inattentive responders if they used the same pattern of answers (e.g., all zeros or all sevens) on one or more questionnaires, with one of the questionnaires having reverse-coded items (e.g., S-DERS). Two hundred and two participants consented to participate in the study. Three participants did not complete the experiment and were removed from the analyses. Finally, 47 participants either failed the attention check (13 participants), were identified as inattentive responders (31 participants), or both (3 participants). The final sample consisted of 152 individuals. Out of these 152 participants, 109 (72%) completed the two-week follow-up surveys.

Out of the 152 participants, 141 reported they have not consumed any food in the two hours prior to the experiment, and 11 participants reported having eaten something two hours or less prior to the experiment. Participants who ate in the two hours prior to

the experiment consumed less low-density food than those who abstained from eating (p = .002), but no differences were found in the intake of high-density food (p = .08).

Participant Characteristics

Participants in the final sample (N = 152) were mostly European American (n = 95; 63%). Other ethnicities reported were Black or African American (n = 19; 13%), Multiracial (n = 18; 12%), Asian or Pacific Islander (n = 9; 6%), and Hispanic/Latino (n = 9; 6%). Participants had a mean age of 19.40 (SD = 2.7) and a range of 18-45 years old. The majority of participants were in their first year of their undergraduate degree (n = 85, 56%), and the rest were in their second year (n = 38, 25%), third year (n = 17, 11%), or fourth year and beyond (n = 11, 7%). The mean body mass index was 25.13 (SD = 6.56) with a range of 16.14 – 50.52. Participant's eating disorder symptoms (measured by EDE-Q-6; Fairburn & Belgin, 1994) ranged from minimal (0) to very high (5.36) with a mean score of 1.58 (SD = 1.26). Twenty-four percent of participants (n = 36) scored above the cut-off of 2.80 (out of possible 6.0), indicating clinically significant ED symptoms (Mond et al., 2008). The participants who scored above clinical cut-off for significant ED symptoms had higher baseline (p < .001) and state ED symptoms (p = .013) and higher difficulties in emotion regulation (p < .001). Because of relatively low number of participants per condition and low number of participants who scored above clinical cut-off per condition, I did not analyze the differences between the groups further.

The mean scores for each of the EDE-Q-6 subscales at baseline were: Restraint (M = 1.33, SD = 1.34), eating concerns (M = 0.79, SD = 1.01), shape concerns (M = 2.60, SD = 1.66), and weight concerns (M = 2.16, SD = 1.58). Twenty-nine percent of

participants (n = 44) reported having previously practiced mindfulness meditation, with the average length of practice being 10 months (SD = 14.28). The length of practice ranged from one week to five years.

Missing Data

Two percent of the data were missing. Little MCAR's test (Little, 1982) indicated that data were missing completely at random (χ^2 = 346.21, p = .150). Missing data were handled using multiple imputation, conducted using the *mice* package in R (Groothuis-Oudshoorn & Van Buuren, 2011). If all follow-up data was missing for a participant, that data was not imputed. Instead, that participant was excluded from the follow-up analyses.

Zero-Order Correlations

All variables were checked for normality and outliers. Please see Table 1 for zero-order correlations across all variables at baseline and time 1. Additionally, I examined whether a change in the outcome variables from time 1 to time 2 correlated with the changes in state mindfulness from time 1 to time 2. These correlations can be found in Table 2.

Differences Across Conditions

Out of 152 participants, 38 (n = 10 above clinical cut-off for an ED) were randomized to mindful eating condition, 38 (n = 8 above clinical cut-off for an ED) to mindful breathing condition, 39 (n = 7 above clinical cut-off for an ED) to mixed mindfulness condition, and 37 (n = 11 above clinical cut-off for an ED) to the control condition. 2. The number of individuals who scored above clinical cut-off for significant ED symptoms was not significantly different across conditions ($\chi 2$ = 1.75, p = .626).

There were no differences across the four conditions in age (p = .579), baseline ED symptoms (p = .611), trait mindfulness (p = .291), state ED symptoms (p = .480), state mindfulness (p = .715), state awareness of hunger, fullness, and satiety cues (p = .189), state rumination (p = .101), or state difficulties in emotion regulation (p = .345). The length of prior meditation practice in months did not differ across the conditions (p = .244). Further, there were no differences in hunger levels during the experiment across the conditions (p = .273).

Manipulation Check

The sphericity assumption was met (χ^2 = .67, p = .715). A mixed two-way ANOVA indicated a significant main effect of time (F(1, 148) = 8.87, p = .003, η^2 = .06). Overall, state mindfulness at time 2 was significantly higher than at time 1 (p = .003, d = .22). Additionally, there was a significant interaction between time and experimental condition (F(3, 148) = 17.21, p < .001, η^2 = .26), meaning that changes in state mindfulness from time 1 to time 2 were significantly different across study conditions. Follow-up Bonferroni comparisons indicated that the change in state mindfulness from time 1 to time 2 in the control condition (M_{change} = - 9.70) was significantly lower than the change in state mindfulness in mindful eating (M_{change} = 2.97; p = .001), mindful breathing (M_{change} = 9.26; p < .001), and mixed mindfulness conditions (M_{change} = 10.77; p < .001). There was no significant difference in the change in state mindfulness between mindful breathing and mixed mindfulness conditions (p = 1.00) or between mindful breathing and mindful eating conditions (p = .290). The difference between mindful eating and mixed mindfulness conditions trended toward significance (greater increase in state mindfulness in the mixed mindfulness condition; p = .085). See Table 3 for mean

differences across the conditions. See Figure 3 for the graph of change in state mindfulness.

Additionally, I tested for order effects in the mixed mindfulness condition (mindful breathing followed by mindful eating versus mindful eating, followed by mindful breathing). There was no difference in state mindfulness at time 2 between the two versions of mixed mindfulness condition ($t(37) = 0.08$, $p = .335$).

The Primary Outcomes: State ED Symptoms and Food Intake

Hypothesis 1: Effect of Mindfulness Induction on State ED Symptoms

1.1. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition Will Lead to Lower State ED Symptoms. Mauchly's test indicated that the assumption of sphericity was met. A mixed two-way ANOVA indicated a significant main effect of time ($F(1, 148) = 21.36$, $p < .001$, $\eta^2 = .12$). Follow-up Bonferroni comparisons indicated that overall state ED symptoms were significantly lower at time 2 compared to time 1 ($p < .001$, $d = .51$) and at time 3 compared to time 1 ($p < .001$, $d = .38$), but there was no difference between time 2 and time 3 ($p = 1.0$, $d = .06$). A time-by-condition interaction was not significant ($F(3, 148) = .12$, $p = .949$).

Although the reduction in state ED symptoms was not significantly different across conditions, effect sizes were calculated to compare effects. Effect size for the reduction of state ED symptoms from time 1 to time 2 was small in the control condition ($d = .26$), medium-to large in the mindful eating ($d = .56$) and the mixed mindfulness ($d = .61$) conditions, and large in the mindful breathing condition ($d = .74$). Effect size for the reduction of state ED symptoms from time 1 to time 3 was small-to-medium in the mindful eating ($d = .30$), mindful breathing ($d = .34$), and the control conditions ($d = .32$),

and medium-to-large in the mixed mindfulness condition (d = .62). Finally, effect size for the reduction of state ED symptoms from time 2 to time 3 was null in the mindful eating condition (d = .00), and very small or negligible in the mindful breathing (d = .17), mixed mindfulness (d = .14), and the control conditions (d = .05). Please see Table 4 for mean differences across the conditions, and Figure 4 for the graph of change in state ED symptoms.

1.2. The Mixed Mindfulness Condition Will Have a Larger Effect on State ED Symptoms Than Mindful Eating and Mindful Breathing Conditions. A mixed two-way ANOVA indicated no differences in the change of state ED symptoms from time 1 to time 2 by study condition (F(3,148 = 1.15), p = .359). The effect size for the reduction of state ED symptoms in the mixed mindfulness condition (d = .61) was similar to the mindful eating condition (d = .56) but smaller than in the mindful breathing condition (d = .74). When mixed mindfulness was compared against mindful eating and mindful breathing conditions collapsed together (the control condition was excluded), the results were not significant (F(1,111)= 0.53, p = .467).

1.3. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition, Will Lead to Lower Baseline ED Symptoms at a 2-Week Follow-up Compared to Baseline. A mixed two-way ANOVA indicated marginally significant main effects of time (F(1, 114) = 2.65, p = .051). Overall ED symptoms at two-week follow-up (M = 1.55; SD = 1.27) were lower than at baseline (M = 1.77; SD = 1.28). The interaction term was not significant (F(3, 114) = 0.45, p = .503). Please see Table 5 for means of ED symptoms at baseline and follow-up across the conditions.

Hypothesis 2: Effect of Mindfulness Induction on Food Intake

2.1. Mindful Eating, Mindful Breathing, and Mixed Mindfulness Conditions Will Lead to a Lower Food Intake Compared to the Control Condition. Total food intake was derived by adding the ounces of consumed apples, popcorn, chocolate, and chips. Low-density food intake was computed by adding the ounces of apples and popcorn, and high-density food intake was computed by adding the ounces of chips and chocolate. These variables were non-normally distributed and, therefore, were transformed using a root transformation. All three variables were approximately normally distributed after the transformation. Individuals who were allergic to any of the foods offered during the experiment (n = 3) were excluded from this analysis. The hunger level was assessed before participants were left alone with food, and no differences in hunger levels were found across the four conditions (F(3, 149) = 1.35, p = .260). Therefore, there was no need to control for hunger levels in the analysis of food intake. A univariate ANOVA indicated that the amount of total food intake did not differ across the four conditions (F(3, 145) = 1.27, p = .288). Similarly, neither low-density (F(3, 145) = 1.90, p = .132) nor high-density (F(3, 145) = 1.27, p = .101) food intake differed across conditions. See Table 6 for the means of food consumed across conditions.

Exploratory Post-Hoc Analyses. The descriptive statistics indicated that participants in the mindful breathing condition may have consumed more high-density food compared to all other conditions. Because the ANOVA may have been under-powered to detect this effect, I conducted a post-hoc multiple regression analysis. Dummy-coded variable 1 (mindful eating vs. all other conditions), dummy-coded variable 2 (mindful breathing vs. all other conditions), and dummy-coded variable 3 (mixed mindfulness vs. all other conditions) were entered as IVs, and high-density food

intake was entered as a DV. Indeed, participants in the mindful breathing condition consumed significantly more high-density food compared to all other conditions (β = .23, Part r = .19, p = .022). There were no such effects for the mindful eating (p = .260) or mixed mindfulness (p = .732) conditions.

Although hunger did not differ across conditions, I wanted to test whether hunger may moderate the effect of mindfulness induction on food intake. Marchiori and Papies (2014) found that hunger moderated the relationship between experimental condition (mindfulness body scan vs. audiobook), such that individuals in the audiobook but not the mindfulness condition ate more "unhealthy" food when hungry. I conducted post-hoc moderation analyses to test if I could replicate these results.

In two separate regression models, dummy-coded experimental conditions and hunger were entered as IVs, and low-density food intake and high-density food intake were entered as DVs. There were no interactions between the effects of hunger and experimental conditions on low-density food intake (ps > .460). However, there was a significant interaction between dummy-coded variable 2 (mindful breathing vs. all other conditions; p = .019) and hunger, as well as between dummy-coded variable 3 (mixed mindfulness vs. all other conditions; p = .009) and hunger. A simple slopes analysis was conducted to probe both interactions to test what was driving the interactions. In mindful breathing versus other conditions analysis, probing revealed that higher hunger levels predicted greater high-density food consumption in the mindful breathing condition (slope β = .15, p = .001), but not in the other conditions (slope β = -.01, p = .911). Similarly, in the mixed mindfulness versus other conditions analysis, probing revealed that higher hunger levels predicted greater high-density food consumption in the mixed

mindfulness condition (slope β = .52, p < .001), but not in the other conditions (slope β = .04, p = .489). Please see Figures 5 and 6 for the interaction graphs and Table 7 for the regression tables.

2.2. The Mixed Mindfulness Condition Will Have a Larger Effect on Total Food Intake Than the Mindful Eating and Mindful Breathing Conditions. A univariate ANOVA indicated that the amount of total food intake did not differ across the four conditions (F(3, 145) = 1.27, p = .288). When mixed mindfulness was compared against mindful eating and mindful breathing conditions collapsed together (control condition excluded), the results were not significant (F(1,111)= 0.17, p = .679).

The Role of Trait Mindfulness and Baseline ED Symptoms

Hypothesis 3: Trait Mindfulness and Experimental Conditions Will Interact in Their Effect on State ED Symptoms and Total Food Intake

In this model, the IVs included: Dummy-coded experimental conditions, baseline trait mindfulness, and interaction terms between each condition and baseline trait mindfulness. In the first model, a difference score of state ED symptoms measured at time 1 minus state ED symptoms measured at time 2 was entered as the DV. A multiple regression found no significant main effect of condition (ps > .333) or trait mindfulness (p = .863). Trait mindfulness and experimental condition interactions were also not significant (ps > .357). In the second model, total food intake was entered as the DV. A multiple regression found no significant main effect of condition (ps > .523) or trait mindfulness (p = .971). Trait mindfulness and experimental condition interactions were also not significant (ps > .711). When low-density and high-density food intake were tested separately as DVs, no main effects or interactions were significant (ps > .422).

Post-hoc exploratory analyses were conducted to test if the length of prior meditation practice (in months) interacted with the study conditions in their effect on the change in state ED symptoms or food intake. The multiple regressions found no significant main effects by length of meditation practice (*p*s > .243) and no interaction effects (*p*s > .185).

Hypothesis 4: Baseline ED Symptom Severity and the Experimental Conditions Will Interact in Their Effect on State ED Symptoms and Total Food Intake

State ED Symptoms. In this model, the IVs included: Dummy-coded experimental conditions, baseline ED symptoms, and interaction terms between each condition and baseline ED symptoms. In the first model, a difference score of state ED symptoms measured at time 1 minus state ED symptoms measured at time 2 was entered as the DV. A multiple regression found no main effect of baseline ED symptoms (p = .996) and no significant main effect of condition (*ps* > .251). Interactions between baseline ED symptoms and dummy-coded variable 1 (mindful eating vs. all other conditions) and dummy-coded variable 2 (mindful breathing vs. all other conditions) were not significant (*ps > .211*), but there was a significant interaction between dummy-coded variable 3 (mixed mindfulness vs. all other conditions) and baseline ED symptoms (p = .008). A simple slopes analysis was conducted to probe the interaction. The analysis revealed that higher baseline ED symptoms predicted greater reduction of state ED symptoms post-manipulation in the mixed mindfulness condition (slope β = .23, p < .001), but not in the all other conditions (slope β = .00, p = .100). These results indicate that individuals with higher baseline ED symptoms, on average, experienced greater reductions in state ED symptoms than those with lower baseline ED symptoms after the

mixed mindfulness condition, but not after all other conditions. Please see Figure 7 for the interaction graph and Table 8 for regression coefficients.

Post-hoc exploratory analyses were conducted to test which types of baseline ED symptoms may explain this effect. In four separate moderation analyses, the following subscales of the EDE-Q-6 were tested as moderators: Restraint, eating concerns, shape concerns, and weight concerns. The interaction terms were significant for eating concerns (p = .001) and shape concerns (p = .012) and marginally significant for restraint (p = .048). The interaction term for weight concerns was not significant (p = .172). Please see Appendix 3 for the interaction graphs.

Food Intake. In this model, total food intake was entered as the DV. A multiple regression found no main effect of condition or baseline ED symptoms, and there were no significant interactions (ps > .414). Next, low-density and high-density food intake were tested separately as DVs. There were no significant main effects or interactions (ps > .461) for low-density food intake as the outcome. With high-density food intake as the outcome, there was a main effect of baseline ED symptoms (p = .036): Individuals who were higher in baseline ED symptoms ate less high-density foods than those low in baseline ED symptoms, on average. The interaction between dummy-coded variable 2 (mindful breathing vs. all other conditions) and baseline ED symptoms was also significant (p = .035). Probing analyses revealed that individuals high in baseline ED symptoms consumed more high-density food in the mindful breathing condition than individuals in all other conditions (β =.43, p = .003) on average. For individuals low in baseline ED symptoms, high-density food intake was not different in the mindful breathing compared to all other conditions (β = -.05, p = .649). There were no main

effects of any of the conditions (*p*s > .642), and no other interactions were significant (*p*s > .333). Please see Figure 8 for the interaction graphs and Table 9 for regression coefficients.

Post-hoc exploratory analyses were conducted to test which types of baseline ED symptoms may explain this effect. In four separate moderation analyses, the following subscales of the EDE-Q-6 were tested as moderators: Restraint, eating concerns, shape concerns, and weight concerns. The interaction term was significant for shape concerns ($p = .010$) and marginally significant for weight concerns ($p = .061$). The interaction terms for restraint and eating concerns were not significant (*p*s > .140). Please see Appendix 4 for the interaction graphs.

Secondary Outcomes

Hypothesis 5. Effect of Mindfulness Induction on State Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues

5.1. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition Will Lead to Reduced State Rumination. Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of time ($\chi^2 = 29.50$, $p < .001$). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .84$). A mixed two-way ANOVA indicated a significant main effect of time ($F(1.69, 250.47) = 60.86$, $p < .001$, $\eta^2 = .29$). Pairwise Bonferroni comparisons indicated that state rumination was significantly lower at time 2 ($p < .001$, $d = .64$) and time 3 ($p < .001$, $d = .75$) compared to time 1. There was no difference in state rumination between times 2 and 3 ($p = .112$, $d = .13$). The time by condition interaction was not significant ($F(5.08, 250.47) = 1.62$, $p = .155$), indicating that change in state

rumination across the three time points did not differ by condition. Although a reduction in state rumination was not significantly different by condition, effect sizes were calculated to compare effects. Effect sizes for the reduction of state rumination from time 1 to time 2 were medium in mindful eating (d = .53) and mixed mindfulness conditions (d = .50), and large in the mindful breathing (d = .83) and the control conditions (d = .72). Effect sizes for the reduction of state rumination from time 1 to time 3 was medium-to-large in the mindful breathing (d = .59) and mixed mindfulness conditions (d = .56) and large in the mindful breathing (d = 1.04) and control conditions (d = .82). Effect sizes for the reduction of state rumination from time 2 to time 3 were very small in mindful eating (d = .12), mindful breathing (d = .11), and mixed mindfulness conditions (d = .07), and small in the control condition (d = .21). Please see Table 10 for mean differences across the conditions and Figure 9 for the graph of change in state rumination.

5.2. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition Will Lead to Reduced State Difficulties in Emotion Regulation. Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of time (χ^2 = 24.07, p < .001). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (ε = .87). A mixed two-way ANOVA indicated a significant main effect of time (F(1.74, 257.16) = 18.12, p < .001, η^2=.11). Pairwise Bonferroni comparisons indicated that overall state difficulties in emotion regulation were significantly lower at time 2 (p < .001, d = .35) and time 3 (p < .001, d = .41) compared to time 1. There was no significant difference between state difficulties in emotion regulation at time 2 and time 3 (p = .401, d = .14). A time-by-condition interaction was not significant (F(5.21, 257.16) = .54, p = .749). Although a reduction in

state difficulties in emotion regulation was not significantly different by condition, effect sizes were calculated to compare effects. Effect sizes for the reduction of state difficulties in emotion regulation from time 1 to time 2 were medium in the mindful breathing (d = .43), mixed mindfulness (d = .40), and the control conditions (d = .36) and small in the mindful eating condition (d = .19). Effect sizes for the reduction of state difficulties in emotion regulation from time 1 to time 3 were medium in the mindful breathing (d = .57), mixed mindfulness (d = .44), and the control conditions (d = .38) and small in the mindful eating condition (d = .26). Effect sizes for the reduction of state difficulties in emotion regulation from time 2 to time 3 were very small in the mindful eating (d = .08), mindful breathing (d = .15), mixed mindfulness (d = .15), and the control conditions (d = .02). Please see Table 11 for mean differences across the conditions and Figure 10 for the graph of change in state difficulties in emotion regulation.

Post-hoc analyses were conducted to identify which factors of difficulties in emotion regulation are driving this effect in each condition. Paired sample t-tests indicated that mindful eating reduced nonacceptance of emotions ($t(37) = 2.75$, $p = .005$, d = .48), but not impulse control difficulties, lack of emotional clarity, or lack of awareness of emotions (ps > .251). Mindful breathing reduced nonacceptance of emotions ($t(37) = 2.96$, $p = .009$, d = .44), impulse control difficulties ($t(37) = 2.11$, p = .042, d = .34), and lack of emotional clarity ($t(37) = 2.21$, $p = .033$, d = .36), but not lack of awareness of emotions (p = .379). Mixed mindfulness reduced nonacceptance of emotions ($t(38) = 2.44$, $p = .014$, d = .39) and impulse control difficulties ($t(38) = 2.16$, p = .037, d = .34), but not lack of emotional clarity or lack of awareness of emotions (ps > .182). The control condition reduced nonacceptance of emotions ($t(36) = 3.26$, $p = .002$, d

= .53), but not difficulty modulating emotions, difficulties with emotion clarity, or lack of emotional awareness (*p*s > .151). None of the results remained significant after Bonferroni adjustment for multiple comparisons ($p = .002$), but the effect sizes were notable.

5.3. Mindful Eating, Mindful Breathing, and Mixed Mindfulness, but Not the Control Condition, Will Lead to Increased State Awareness of Hunger, Fullness, and Satiety Cues. Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of time ($\chi^2 = 25.37$, $p < .001$). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .89$). A mixed two-way ANOVA indicated a significant main effect of time ($F(1.72, 255.50) = 28.07$, $p < .001$, $\eta^2 = .16$). Pairwise Bonferroni comparisons indicated that overall state awareness of hunger, fullness, and satiety cues was significantly higher at time 2 ($p < .001$, $d = .54$) and time 3 ($p < .001$, $d = .50$) compared to time 1. There was no difference in state awareness of hunger, fullness, and satiety cues between times 2 and 3 ($p = .260$, $d = .14$). A time-by-condition interaction was not significant ($F(5.17, 255.50) = 0.69$, $p = .634$). Although increases in state awareness of hunger, fullness, and satiety cues were not significantly different by condition, effect sizes were calculated to compare effects. Effect sizes for the increase in state awareness of hunger, fullness, and satiety cues from time 1 to time 2 were medium in the mindful eating ($d = .51$), mixed mindfulness ($d = .49$), and the control condition ($d = .41$) and large in the mindful breathing condition ($d = .83$). Effect sizes for the increase in state awareness of hunger, fullness, and satiety cues from time 1 to time 3 were medium-to-large in the mindful eating ($d = .50$) and mixed mindfulness conditions ($d = .54$) and large in the mindful breathing ($d = .73$) and the

control condition (d = .82). Effect sizes for the increase in state awareness of hunger, fullness, and satiety cues from time 2 to time 3 were very small in the mindful eating (d = .08) and mixed mindfulness conditions (d = .08), and small in the mindful breathing (d = .24) and the control conditions (d = .16). Please see Table 12 for mean differences across the conditions and Figure 11 for the graph of change in state awareness of hunger, fullness, and satiety cues.

Mediation Analyses

Hypothesis 6.1. Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues Will Mediate the Effect of the Mindfulness Induction on the Reduction of State ED Symptoms

For this analysis, I was interested in whether the *change* in the proposed mediator variables that occurred as a result of the mindfulness exercises resulted in further change in state ED symptoms. Therefore, the following difference scores were computed: Change in state rumination, change in state difficulties in emotion regulation, and change in state awareness of hunger, fullness, and satiety cues from time 1 to time 2; Change in state ED symptoms from time 2 to time 3. Path model analysis was conducted to test if there were indirect effects of change in state rumination, state difficulties in emotion regulation, and state awareness of hunger, fullness, and satiety cues on change in state ED symptoms across the experimental conditions. Model fit was excellent (CFI = 1.00, TLI = 1.00, RMSEA = <0.01, SRMR = .02). The mindful breathing condition resulted in a greater increase in state awareness of hunger, fullness, and satiety cues compared to all other conditions (β = -.18, p = .020). No other model paths were significant (ps > .072). See Figure 12 for the full model results.

There was no indirect effect of mindful eating (Estimate = -.01, 95% CI = -. 03 to .02), mindful breathing (Estimate = .01, 95% CI = -.02 to .04), or mixed mindfulness condition (Estimate = .00, 95% CI = -.03 to .02) on change in state ED symptoms through the change in state rumination. There was no indirect effect of mindful eating (Estimate = .01, 95% CI = -.03 to .05), mindful breathing (Estimate = .00, 95% CI = -.04 to .03) or mixed mindfulness condition (Estimate = -.01, 95% CI = -.05 to .03) on change in state ED symptoms through the change in state difficulties in emotion regulation. There was no indirect effect of mindful eating (Estimate = -.02, 95% CI = -.05 to .02), mindful breathing (Estimate = -.02, 95% CI = - .05 to .01), or mixed mindfulness condition (Estimate = -.01, 95% CI = - .04 to .02) on change in state ED symptoms through the change in awareness of hunger, fullness, and satiety cues.

Hypothesis 6.2. Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues Will Mediate the Effect of Mindfulness Induction on Lower Food Intake.

For this analysis, I was interested in whether the *change* in the proposed mediator variables that occurred as a result of the mindfulness exercises predicted participants' food intake. Therefore, the following difference scores were computed: Change in state rumination, state difficulties in emotion regulation, and state awareness of hunger, fullness, and satiety cues from time 1 to time 2. A path model analysis was conducted to test if there were indirect effects of change in state rumination, state difficulties in emotion regulation, and state awareness of hunger, fullness, and satiety cues on total food intake across the experimental conditions. Model fit was excellent (CFI = 1.00, TLI = 1.00, RMSEA = < 0.01, SRMR = .02). The mindful breathing condition resulted in a

greater increase in state awareness of hunger, fullness, and satiety cues compared to all other conditions (β = -.18, p = .020). No other model paths were significant (ps > .07). See Figure 13 for the full model results.

There was no indirect effect of mindful eating (Estimate = -.01, 95% CI = -. 02 to .02), mindful breathing (Estimate = .00, 95% CI = -.03 to .02), or mixed mindfulness condition (Estimate = .00, 95% CI = -.02 to .02) on total food intake through the change in rumination. There was no indirect effect of mindful eating (Estimate = .01, 95% CI = -.02 to .05), mindful breathing (Estimate = .00, 95% CI = -.03 to .03), or mixed mindfulness condition (Estimate = -.01, 95% CI = -.04 to .03) on total food intake through the change in state difficulties in emotion regulation. There was no indirect effect of mindful eating (Estimate = .01, 95% CI = -.03 to .04), mindful breathing (Estimate = .01, 95% CI = - .03 to .04), or mixed mindfulness condition (Estimate = -.00, 95% CI = - .02 to .03) on total food intake through the change in awareness of hunger, fullness, and satiety cues.

DISCUSSION

The current study compared the effects of various brief mindfulness exercises (mindful eating, mindful breathing, and mixed mindfulness vs. control) on state ED symptoms and food intake, and tested whether a reduction in state rumination, decrease in state difficulties in emotion regulation, and an increase in state hunger, fullness, and satiety awareness mediated these effects. Overall, the study found that all types of mindfulness practices, as well as listening to a story about produce transportation, led to the short-term reduction of state ED symptoms, rumination, difficulties in emotion regulation, and the increase of awareness of hunger, fullness, and satiety cues post-manipulation. However, only a weak effect was found two weeks later. Mindful breathing consistently had more substantial effects on most outcomes and resulted both in higher awareness of hunger, fullness, and satiety cues and in greater high-density food intake compared to all other conditions. Both mindful breathing and mixed mindfulness conditions led to a higher congruency between hunger and high-density food intake. Against hypothesis, individuals high in baseline ED symptoms benefited the most from the mixed mindfulness exercise by experiencing the highest reduction of state ED symptoms post-manipulation. Participants high in baseline ED symptoms also consumed more high-density food after the mindful breathing exercise. No indirect effects of either the decrease in state rumination, reduction in state difficulties in emotion regulation, or an increase in awareness of hunger, fullness, and satiety cues on state ED symptoms or

food intake were found. These results suggest that a variety of mindfulness and related practices (i.e., audio story) may help reduce ED cognitions and urges, but not food intake short-term. More research is needed to elucidate the mechanisms of these effects.

Manipulation Check

The results of the manipulation check indicated that, as expected, all three mindfulness conditions resulted in higher state mindfulness compared to the control condition. State mindfulness increased the most in the mixed mindfulness condition (slightly higher than in the mindful breathing condition) and the least in the mindful eating condition. Interestingly, state mindfulness decreased in the control condition. These results are consistent with prior research showing that even 10-15 minutes of mindfulness meditation practice is enough to induce a mindfulness state (i.e., Garland et al., 2015; Lester & Murrell, 2019; Luberto & McLeish, 2018). This experiment also replicated the results of two previous studies, where mindful eating exercises involving chocolate and other sweets increased participants' state mindfulness (Donald & Atkins, 2016; Mantzios et al., 2019). However, a mindful eating practice alone may be less effective than a mindful breathing meditation at inducing state mindfulness due to focusing participants' attention on the outside stimulus (e.g., raisin) instead of inward (e.g., breath). Recall, that state mindfulness refers to recognizing thoughts and physical sensations as passing mental events and observing them without reacting (Tanay & Bernstein, 2013), which is what a mindful breathing practice encourages participants to do. In contrast, the mindful eating exercise directs participants' attention to the outside stimulus (i.e., raisin). However, participants are encouraged to observe the sensations and thoughts that arise in response to the raisin. Alternatively, each exercise may contribute

its unique incremental value (i.e., mindful breathing teaching fundamental mindfulness skills, and mindful eating showing how to apply them to everyday activities, such as eating), making the mixed mindfulness exercise the most effective at inducing state mindfulness. Further studies are needed to clarify these questions.

Interestingly, the control exercise (recording about transportation of produce) not only failed to induce state mindfulness, but participants in this condition experienced a reduction in state mindfulness, meaning that they were less mindful. Recall that in this condition, participants were asked to let their mind wander without focusing on anything in particular. The recording may have distracted participants from observing their internal experiences, making individuals even less present with their thoughts and emotions after the exercise compared to before. Mind-wandering is a term used to describe imagery and thoughts unrelated to a task and occurring independently of any stimulus, which often occurs during tedious tasks (Seli et al., 2016). Mindfulness practices aim to achieve a state of attention, opposite of mind-wandering (Kabat-Zinn, 1990). For example, a breathing meditation practice encourages participants to notice when the mind has wandered and to bring attention to the breath. The control condition may have induced a state of mind-wandering, which consequently may have reduced participants' state mindfulness scores.

Primary Outcomes: State ED Symptoms and Food Intake

State ED Symptoms

As hypothesized, mindful eating, mindful breathing, and mixed mindfulness conditions resulted in a reduction of state ED symptoms. Contrary to my prediction, there was no combined effect of the mixed mindfulness condition, and, unexpectedly, the

control condition also led to the reduction of state ED symptoms. The mindful breathing exercise had the largest effect on state ED symptoms, mindful eating and mixed mindfulness exercises had a moderate effect, and the control exercise had a small effect, suggesting that mindful breathing may be the most beneficial practice of all. The effects were maintained until the end of the experiment, with state ED symptoms remaining stable when participants were left alone with food. However, long-term outcomes of these exercises remain unclear. A small (marginally significant) reduction in baseline ED symptoms was observed two weeks following this study, suggesting that the effects of 15-minute one-time mindfulness practices are limited. Repeated mindfulness practices are likely needed to achieve a lasting impact. Future studies should test the effect of multi-session mixed mindfulness interventions (e.g., once per day for a week) on ED symptoms.

Considering that the control condition did not increase participants' state mindfulness, it is plausible that it lowered ED symptoms through relaxation or distraction. The control condition (a recording about produce transportation from farm to market) had the same tone and pace as the mindfulness conditions. Thus, it may have had a calming effect, similar to that of a guided imagery exercise (i.e., bringing up relaxing mental images, such as beach or garden, and engaging the senses of smell, touch, and sounds; Bigham et al., 2014). Lancaster et al. (2016) directly compared brief mindfulness and relaxation exercises and found similar results. Both exercises led to decreased anxiety, but only mindfulness meditation increased state mindfulness (Lancaster et al., 2017). Relaxation exercises, such as art therapy, aromatherapy, progressive muscle relaxation, or visualization, are widely used in health and psychotherapy interventions

and are effective at improving sleep, lowering blood pressure, decreasing anxiety and chronic pain, and reducing stress (e.g., Crawford et al., 2013; Kaushik et al., 2006; de Niet et al., 2009). Although both mindfulness meditation and relaxation exercises may reduce symptoms short-term, there is evidence that benefits of mindfulness meditation are maintained long-term (Alsubaie et al., 2017; Gu et al., 2015; van der Velden et al., 2015). However, little is known about how relaxation works, or about its long-term effects. Functionally, relaxation may be similar to distraction, a coping technique, in which individuals redirect their attention to less distressing stimuli (Janson & Rohleder, 2017). Distraction is considered a form of avoidance, common in those with EDs (Cowdrey et al., 2013). Distraction is very effective at reducing distress short-term but likely contributes to the maintenance of psychopathology long-term (Vanzhula et al., 2020; Wheaton et al., 2018). More research on the long-term effects of relaxation and distraction is needed before it can be considered as an alternative to mindfulness practices. Future studies should attempt to further delineate the effects of various mindfulness and relaxation practices on ED symptoms and to test their short-term and long-term effects.

Food Intake

Contrary to the hypotheses, the mindful breathing exercise led to a *greater* high-density food intake compared to all other conditions. There were no other differences in total, low-density, or high-density food intake across conditions. This finding is surprising, considering multiple other experiments documenting *lower* high-density food intake in mindfulness conditions compared to control (Allirot et al., 2018; Jenkins & Tapper, 2014; Mantzios et al., 2019; 2020; Seguias & Tapper, 2018). The earlier studies

primarily presented participants with sweets (e.g., cookies, chocolates), and one study used grapes as a proxy for "healthy" foods (Dutt et al., 2019). There was high variability in measurement, with studies comparing caloric intake, the number of pieces consumed, or grams consumed, which makes it challenging to compare results across the experiments. However, the average amount of chocolate consumed in this study was similar to that of other studies that measured intake by weight (Dutt et al., 2019; Mantzios et al., 2019). Only one other experiment used a variety of foods, including chips. Arch et al. (2016) found that neither the consumption of "healthy" (carrots and almonds) nor "unhealthy" (chocolates and chips) foods differed between mindful eating and distraction conditions. To my knowledge, the current experiment is the first that found mindfulness meditation leading to a greater consumption of high-density foods. Although previous studies conceptualize greater higher-density food intake as an "unhealthy" response to emotional distress (Marchiori & Papies, 2014), another possible explanation is that participants ate more food because they were truly hungry. Indeed, I found that mindful breathing led to a higher awareness of hunger, fullness, and satiety cues compared to all other conditions. Therefore, the greater intake of high-density food in this condition may indicate that participants were eating more food in response to recognizing their hunger.

Indeed, in the post-hoc analyses, I found that hunger moderated the effect of mindfulness induction on high-density food intake, such that participants in the mindful breathing and mixed mindfulness conditions, on average, consumed a more substantial amount of high-density foods if they were more hungry and less food if they were less hungry. In contrast, this effect was not present in either the mindful eating or control

conditions. These findings contradict Marchiori and Papies' (2014) experiment, where participants in the control, but not the mindfulness condition, consumed more if they were hungry. Marchiori and Papies (2014) explained their results by suggesting that mindfulness practice prevented hunger from leading to "unhealthy" snacking and overeating (the experiment used chocolate chip cookies). One potential issue with this explanation is that it suggests that hunger should be ignored if the available food is "unhealthy." New research suggests that such a rigid and restrictive attitude to eating can be no less problematic than excessive overeating and can also be considered disordered (e.g., Dunn & Bratman, 2016; Zickgraf et al., 2019). Instead, it is suggested that individuals should listen to their hunger cues and use them to guide food intake, as well as be flexible with food choices, and not eliminate a food group from one's diet (Bruce & Ricciardelli, 2016; Triboli & Resch, 2003). Consistent with this theory, the individuals in the mindful breathing and mixed mindfulness conditions in this study may have eaten more food when hungrier because the mindfulness induction made them more aware of their hunger cues. This explanation is particularly likely because participants with higher baseline ED symptoms overall ate less high-density food, not more.

Overall, these results suggest that the induction of the mindfulness state may help individuals adjust their intake of energy-dense foods according to their hunger levels. However, hunger is a complex construct, and future research should attempt to delineate whether these effects are driven by participants experiencing true physical hunger (body signaling that its low on energy) or, perhaps, psychological hunger (craving food due to proximity or emotional state; Kristeller & Wolever, 2010). Differentiating between these

two types of hunger and using this awareness to guide eating behavior may help to achieve balanced eating.

Do Trait Mindfulness and Baseline ED Symptoms Moderate the Primary Outcomes?

Contrary to my hypotheses, trait mindfulness did not amplify the effects of the mindfulness induction. The quantity of prior mindfulness meditation practice also did not interact with the study conditions. Further, neither trait mindfulness nor the quantity of prior meditation practice were associated with the change in state ED symptoms or amount of food consumed during the experiment. Prior research suggests that repeatedly evoking state mindfulness over multiple occasions contributes to increased trait mindfulness over time (Kiken et al., 2015), and that length of experience is associated with higher trait mindfulness (Soler et al., 2014). However, the results of this study imply that levels of trait mindfulness may not play a role in whether an individual can benefit from a brief mindfulness induction. This finding is encouraging because it suggests that even individuals with ED who have lower trait mindfulness than the general population (Adams et al., 2012) may benefit from mindfulness meditation, pending replication of these results in clinical samples.

As hypothesized, baseline ED symptoms moderated the effect of the study conditions on change in state ED symptoms and high-density food intake, but not in the way I initially predicted. I hypothesized that individuals with high baseline EDs symptoms might receive less benefit from mindfulness induction than those with low baseline ED symptoms because they would have some difficulty engaging in mindfulness exercises and may experience increased distress during the practice (Cowdrey & Park,

2012). This effect was not observed. On the contrary, in the mixed mindfulness condition, participants with high levels of baseline ED symptoms (specifically, high eating concerns, shape concerns, and cognitive restraint) experienced greater reductions of state ED symptoms than those with low levels of baseline ED pathology. These results suggest that mindful breathing and mindful eating combined were particularly effective in reducing state ED symptoms for individuals with clinical or subclinical EDs. If replicated, these findings support the inclusion of both practices into MBTs for EDs (Kristeller & Wolever, 2010). Kristeller and Wolever (2010) suggested that breathing meditation practice teaches general skills of awareness of the present moment and seeing thoughts and emotions as transient events. Mindful eating then allows participants to apply these skills to eating. There is existing evidence that eating, shape, and weight concerns decrease at the end of a mixed mindfulness intervention (Duarte et al., 2017). However, to my knowledge, this study is the first to suggest that individuals high in cognitive restraint may also benefit from mindfulness meditation. If replicated in the clinical ED sample, this finding has implications for expanding mindfulness-based interventions to a broader range of ED psychopathology, including restrictive presentations.

Baseline ED symptoms also moderated the effect of study condition on high-density food intake. After the mindful breathing practice, those who were high in baseline ED symptoms (specifically, high shape and weight concerns) consumed more high-density food than those low in baseline ED symptoms. This effect was not present in other conditions. There are two potential explanations of this effect. Individuals with EDs (including those who also engage in binge eating) experience high anxiety around high

fat and high carb foods and tend to restrict their intake of such foods (Levinson & Byrne, 2015). Thus, it is possible that mindful breathing reduced food anxiety and allowed participants with high baseline ED symptoms to consume more high-density foods. This explanation is likely considering that, overall, higher baseline ED symptoms were associated with lower high-density food intake. Alternatively, the mindfulness exercises may have caused participants with high baseline ED symptoms to experience distress from being present with their emotions (as previously reported by Cowdrey & Park, 2012). Greater consumption of high-density foods could then represent a maladaptive way to regulate such distress (Corstorphine, 2006). The interpretation of these results is further complicated by the fact that EDs are incredibly complex, and both restriction and binge eating are present across all ED diagnoses. In the current study, eating concerns (primarily binge eating-related symptoms) and restraint subscales of the EDE-Q-6 were not significant moderators, meaning that high-density food intake did not differ between those experiencing high vs. low levels of these symptoms. This finding could be explained by relatively low levels of restraint and eating concerns in a non-clinical sample (in contrast, shape and weight concerns averages were in the clinical range). Future research should attempt to clarify these questions by testing binge eating and food restriction as moderators in a clinical ED sample. If mindfulness is found to reduce food anxiety and food restriction, it would have implications for treatment, and specifically, meal therapy.

Secondary Outcomes: State Rumination, Difficulties in Emotion Regulation, and Awareness of Hunger, Fullness, and Satiety Cues

State Rumination

Partially consistent with the hypothesis, I found that all study conditions, including the control condition, resulted in reduced state rumination post-induction. The effects were the largest in mindful breathing and control conditions, and moderate in mindful eating and mixed mindfulness conditions. Rumination levels remained stable during the second part of the study when participants were left alone with food for 10 minutes. These results are consistent with a large body of research showing that mindfulness meditation reduces rumination (Alsubaie et al., 2017). However, the reduction of state rumination in the control condition is surprising. I would expect that a period of time when the mind is left to wander and focus on "nothing in particular" may, in contrast, increase state rumination.. As outlined above in the discussion of state ED symptom reduction, these results may be due to the relaxation or distraction effects of the control condition. There is some evidence that distraction at least temporarily reduces state rumination (Hilt & Pollak, 2012). Further, mind wandering may not necessarily prompt ruminative thoughts. For example, Baars (2010) separates spontaneous thoughts (i.e., mind-wandering) from brooding rumination and suggests that spontaneous thoughts may instead manifest as reflection and moments of creativity, especially in a non-clinical sample. Healthy individuals may be less prone to a ruminative response than those with higher levels of psychopathology (Rood et al., 2009). Future studies should attempt to replicate these results in a clinical sample.

State Difficulties in Emotion Regulation

All study conditions, including the control condition, led to a reduction of state difficulties in emotion regulation with moderate effects for all mindfulness conditions and small effects for the control condition. Change in state difficulties in emotion regulation was not significantly associated with changes in state mindfulness in any of the study conditions. Emotion regulation may have improved through mechanisms other than an increase in state mindfulness, such as distraction or a decrease in physiological stress response. For example, a recent meta-analysis found that a brief mindfulness induction improved emotion regulation through attention redeployment (i.e., redirecting attention away from the emotional experience; Leyland et al., 2019). The researchers concluded that mindfulness induction performed as well as a distraction in improving emotion regulation. However, both were more effective than mind-wandering control conditions involving no task (Leyland et al., 2019). In the current study, all conditions encouraged participants to redirect their attention either internally (i.e., towards their breath) or externally (i.e., towards sensations of eating a raisin or a story about transportation of produce).

Through attention redeployment, both mindfulness meditation and distraction may reduce an individual's stress response (i.e., lower cortisol and physiological arousal). The physiological stress response is known to impair cognitive emotion regulation (Jentsch et al., 2019). By reducing physiological arousal, both mindfulness meditation and distraction may improve individuals' abilities to engage in cognitive reappraisal (i.e., ability to regulate emotions by reconstruing the meaning of events) and help them take a non-judgmental stance towards emotional experiences (Leyland et al., 2019). Indeed,

when specific facets of emotion regulation were examined in this study, nonacceptance of emotions (i.e., the tendency to judge self for experiencing emotions) was significantly lower post-manipulation across all four conditions. These findings support the theory that mindfulness improves emotion regulation through acceptance of emotions (Lindsay and Creswell, 2019). In addition to nonacceptance, the mixed mindfulness condition also reduced impulse control difficulties (i.e., perceiving emotions as overwhelming and difficulty controlling urges to act on emotion). In addition to nonacceptance, the mindful breathing condition also improved impulse control difficulties and lack of emotional clarity (i.e., lack of understanding of how one feels). These results suggest that various mindfulness and relaxation practices may target different types of emotion regulatory processes, with mindful breathing likely being the most beneficial.

Awareness of Hunger, Fullness, and Satiety Cues

Consistent with the other outcomes of this study, I found that all four conditions led to an increased awareness of hunger, fullness, and satiety cues (i.e., eating awareness), with a large effect in the mindful breathing condition and moderate effects in the other conditions. Further, mindful breathing led to a significantly higher increase in awareness of hunger, fullness, and satiety cues compared to all other conditions. This result is consistent with the prior research showing that mindfulness meditation improves interoceptive sensitivity (Bornemann et al., 2015; Fischer et al., 2017). Unlike the mindful eating and the story about produce transpiration, mindful breathing guides participants to focus their attention inward and onto the flow of breath. Such an attention shift helps participants become more aware of their bodies and likely helps them recognize the sensations of hunger and fullness. Additionally, mindfulness is known to

reduce the physiological stress response (Matousek et al., 2010), which often obscures true hunger and fullness cues (Klatzkin et al., 2019). In the mixed mindfulness condition, the seven and a half minutes of mindful breathing may not have been enough to produce an effect similar to 15 minutes of mindful breathing. Surprisingly, the control condition also improved hunger, fullness, and satiety awareness. Possibly, just the act of settling in and slowing down for 15 minutes to listen to a story may have made participants more aware of their body and its needs. Future studies testing the effect of mindfulness practices on awareness of hunger, fullness, and satiety cues should include physiological measures of interoceptive awareness (e.g., heart rate detection task; Schandry, 1981) to assess if participants are indeed more aware of their body sensations after these mindfulness practices.

Mechanisms of Action of the Brief Mindfulness Induction

The mediation hypotheses were not supported. Contrary to my prediction, neither reduction in rumination, nor a decrease in difficulties in emotion regulation, nor improvement in awareness of hunger, fullness, and satiety cues had an indirect effect on state ED symptoms or food intake. One possible reason for failing to find these effects for state ED symptoms is the experiment design. The longitudinal mediation model in this study tested whether the change in rumination, difficulties in emotion regulation, and awareness of hunger, fullness, and satiety cues from time 1 to time 2 mediated the effect of the study conditions on change of state ED symptoms from time 2 to time 3. However, the significant change in state ED symptoms happened only from time 1 to time 2 (during the audio exercise), and no change occurred from time 2 to time 3 (when participants were left alone with food). Therefore, the outcome variable (change in state ED

symptoms from time 2 to time 3) had little variance to be explained. Future studies should measure potential mediators in the middle of the mindfulness practice, rather than at the end, to capture indirect effects. It is also possible that brief mindfulness induction is not sufficient to detect the mechanisms of action, and recurring sessions (e.g., four brief sessions over several days) are needed. Finally, the mechanisms of action in brief mindfulness induction on state ED symptoms may be different from the mechanisms in longer MBTs for EDs (several weeks or months). It may take several sessions of mindfulness practices for reduced rumination, improved emotion regulation, and increased awareness of hunger, fullness, and satiety cues to affect ED cognitions and behaviors. Instead, in the short term, mindfulness may improve ED symptoms through attentional redeployment (i.e., shifting attention away from distressing stimulus; Leyland et al., 2019).

There were no indirect effects on total food intake. The food intake also did not differ across study conditions (except for greater intake of high-density food in the mindful breathing condition), and neither reduction of state rumination, nor reduction in difficulty regulating emotions, nor increase in awareness of hunger, fullness, and satiety cues predicted food intake. Therefore, the lack of indirect effects was not surprising. Longer mindfulness practices may be needed (i.e., a week of daily practices Jenkins & Tapper, 2014), or different types of foods should be used (i.e., primarily highly palatable foods such as chocolates, cookies, or candy) to detect significant indirect effects. Further, as discussed earlier, it is unclear how to best conceptualize such food intake in a laboratory as a proxy for eating behaviors. It is difficult to ascertain whether less or more intake of a specific type of food represents an adaptive eating behavior, as both

consuming too little (i.e., restriction) and too much food (i.e., binge eating) can be considered disordered. Additionally, the cognitions related to the food intake, rather than the intake itself, may mark disordered eating. For example, subjective binge eating episodes (experiencing loss of control over eating while consuming an *average* amount of food) are associated with just as much impairment as objective binge eating episodes (experiencing loss of control over eating while consuming an *unusually large* amount of food; Li et al., 2019). Future studies using food intake as a proxy for eating behaviors should access participant's cognitions about the food intake.

Unique Benefits of Mindful Breathing

This study presented evidence for a potentially unique role of mindful breathing in psychological and physiological processes. Mindful breathing consistently had more substantial effects on most outcomes and resulted both in higher awareness of hunger, fullness, and satiety cues and in greater high-density food intake compared to all other conditions. Conditions with a mindful breathing component led to a higher congruency between hunger and high-density food intake. Mindful breathing (through activation of the diaphragm) has been shown to reduce respiration rate, which, in turn, activates a parasympathetic system response reducing physiological stress and anxiety response and activating the "rest and digest" state (Zaccaro et al., 2018). A prior study found an increase in hunger following a brief paced breathing exercise, which is likely connected to vagal nerve stimulation (Meule & Kubler, 2017). The vagus nerve is involved in both affect regulation and management of complex processes in the digestive tract, including signaling the muscles in the stomach to contract and push food into the small intestine (Lehrer & Gevirtz 2014). It is possible that vagal nerve stimulation and activation of the

"rest and digest" state may have explained the beneficial effects of mindful breathing exercise in this study and led to increased sensation of hunger. Such effects would differential mindful breathing from mindful eating exercises, as the latter does not specifically guide participants through breathing practice. Future studies should examine the changes in respiration rate in mindful eating vs. mindful breathing exercises and test respiration rate as a predictor of eating disorder symptoms and food intake outcomes of mindfulness-based interventions.

Implications

This study found that even a brief 15-minute mindfulness practice can temporarily reduce ED cognitions and urges, decrease rumination, and improve acceptance of emotions and awareness of hunger, fullness, and satiety cues. This finding has vast implications for interventions targeting ED symptoms in subclinical populations. A short practice can be conducted in any setting with the use of audio recordings available on the internet or through a phone app. More importantly, although mindful breathing may provide the most benefit, guided practices with a variety of content may be helpful, including informal mindfulness practices (i.e., mindful eating) or even guided imagery or a story read in a calm voice. Many phone applications with a variety of such practices are currently available to consumers: Calm, Headspace, and others. Individuals use these exercises to help curb an urge to restrict, overeat, or engage in other maladaptive ED behaviors. Additionally, these exercises may be helpful in reducing a ruminative or an emotional response to a variety of ED stimuli such as seeing one's weight, being faced with a feared food, or being preoccupied with distressing body image thoughts. Pending replication studies in clinical samples, brief mindfulness practices can be used as in-the-

moment interventions to help individuals with EDs to comply with treatment plan recommendations at home. Therapists could use such practices as grounding techniques to help patients manage their ED thoughts and urges between programming and during meals in intensive outpatient treatment settings. Finally, neither previous mindfulness meditation experience nor level or dispositional mindfulness affected how much participants in this study benefited from such practices. Therefore, these exercises can be used both with patients who are not familiar with mindfulness meditation and those who have had prior experience with it.

The implications for individuals high in ED symptoms are such that the study supported the importance of using a combination of both mindful breathing and mindful eating techniques to achieve the most benefit. Currently, all MBTs for EDs include both general meditation practices (e.g., mindful breathing, body scan) and mindful eating practices. Kristeller and Wolever (2010) consider both as necessary: Formal mindfulness practices teach the skills of awareness, non-judgment, and being in the present moment in general, and mindful eating practices teach participants how to apply these skills to eating behaviors specifically. Although each practice independently decreased state ED symptoms, a mixed mindfulness exercise was particularly effective for individuals with higher baseline ED psychopathology by reducing eating concerns, shape concerns, and restraint. It has been previously thought that mindfulness-based interventions may not be appropriate for individuals with high severity of ED psychopathology (Cowdrey & Park, 2012; Kristeller & Wolever, 2010). However, the results of this study suggest that such individuals may benefit from a combination of mindful breathing and mindful eating interventions. The current study found no evidence of individuals with high levels of

baseline ED symptoms experiencing detrimental effects from any of the mindfulness practices, as was reported previously (Cowdrey & Park, 2012). However, negative affect was not assessed in this study.

Additionally, greater intake of high-density foods in individuals with higher vs. lower baseline ED symptoms after mindful breathing practice may have significant implications for establishing regular eating patterns and achieving nutritional rehabilitation in individuals with EDs. It is unclear whether participants with high baseline ED symptoms consumed more high-density food after mindful breathing versus other conditions because they felt less anxious about the food, or in response to an increased negative affect. Future studies should attempt to clarify this question. I also found that the mindful breathing practice was particularly useful at increasing awareness of hunger, fullness, and satiety cues in this study, and hungry participants, on average, ate more high-density foods in this condition. Given these results, individuals with high baseline ED symptoms may have consumed more high-density food as a result of becoming more aware of their hunger. Most individuals with EDs have difficulty recognizing their hunger and fullness cues, which contributes to food restriction, binge eating, or both (Kristeller & Wolever, 2010). Mindful breathing practice may aid those with EDs in guiding their food intake using hunger and fullness cues rather than relying on external food rules (e.g., dieting rules, proximity to trigger foods). Reliance on internal cues may help individuals with EDs to establish regular eating patterns and increase food intake to achieve nutritional rehabilitation. Overall, pending replication in the clinical samples, these findings are very promising for the treatments of EDs.

Strengths and Limitations

There are several limitations to this study that should be noted. First, this study only tested a brief 15-minute mindfulness induction, and any generalizations of the results to full-length MBTs should be limited. Second, the sample consisted of undergraduate females, and the findings may differ in men and individuals in the older age group. Third, two measures were created for the study and have not been previously validated: State Eating Disorder Symptom survey and Eating Awareness Scale - State. Although I provide evidence of their preliminary psychometric properties, the findings using these scales should be interpreted with caution. Fourth, the initial sample size was significantly reduced due to the invalid responses, and I had fewer participants per each condition than I anticipated. Fifth, all measures, other than food intake, were based on self-report and, therefore, may be biased. Sixth, the study did not control for the time of the day the experiment took place and it may have affected the food intake outcome, although participants were asked not to eat for two hours before the study, and I did control for the level of hunger. Finally, I did not have a no-task control condition to test whether the effects of the four conditions were different from participants doing nothing at all and whether the study effects may merely represent a *regression to the mean* effect (Stigler, 1997). Alternatively, the study effects may be explained by participants' increased self-awareness from completing the baseline questionnaires and wearing the wrist band rather than the intervention. The major strength of the study is that the experimental design allows us to make claims about causality. To my knowledge, this is the first study that directly compared mindful breathing and mindful eating and assessed state ED symptoms as the outcome.

Future Directions

The findings of this study suggest several potential directions for future research. Before any recommendations for MBTs for EDs can be made, several questions should be answered. First, the long-term effects of mindful eating versus mindful breathing versus an audio story should be investigated. Although all study conditions resulted in reduced state ED symptoms, it is not clear whether each practice is equally beneficial long-term. For example, distraction is known to be effective at reducing distress short-term but serves to maintain the psychopathology long-term (Wheaton et al., 2018). Only certain mindfulness practices may have a lasting effect because they teach a particular skill rather than merely providing a distraction. Second, mindfulness interventions longer than one brief session should be evaluated in future studies. A potential next step could be to assign participants to complete a short mindfulness practice once each day for a week and measure daily fluctuations in ED symptoms, state mindfulness, rumination, difficulties in emotion regulation, and awareness of hunger, fullness, and satiety cues. It would be worthwhile to determine the frequency and length of mindfulness practices needed to achieve a lasting change in these outcomes. Third, future experiments should test the effects of these mindfulness practices on ED symptoms following negative mood induction. Negative mood induction allows researchers to reproduce distressing real-life circumstances when participants may need to use coping skills. Various mindfulness practices may have different effects when participants experience high distress. Fourth, psychometric evaluations of the state ED survey and awareness of hunger, fullness, and satiety cues scale used in this experiment should be conducted to allow for the future study of these outcomes by multiple researchers.

The current findings support the need for further investigation into the use of mindfulness practices in the treatment of clinical EDs. The next step is to replicate these findings in a clinical population of individuals with EDs. The previous experiments that examined the effect of mindfulness meditation and mindful eating practices used only undergraduate or community samples (e.g., Dutt et al., 2018; Mantzios et al., 2019, 2020; Marchiori & Papies, 2012). The existing MBTs are well-received by individuals with BED and are effective at reducing binge eating symptoms (e.g., Kristeller et al., 2014; Pinto-Gouveia et al., 2016). Therefore, the findings of this study should be first replicated with clinical and sub-clinical BED populations. The results of such studies can directly inform existing MBTs for binge eating symptoms. Further, future studies should investigate how individuals with other ED diagnoses and clinical presentations respond to mindfulness practices. Although there is a strong theoretical rationale for the use of mindfulness with AN and BN, the research is very limited. Moreover, if the food intake continues to be used as a proxy for eating behaviors, its validity should be re-evaluated. Currently, a lesser intake of high-density foods is considered preferable because the consumption of such foods is conceptualized as overeating or eating "unhealthy." However, a greater consumption of high-density food may indicate symptom improvement in someone with a restrictive ED presentation (i.e., less fear of calorically dense foods). In addition, cognitions related to food intake (e.g., fear of food, desire to restrict or binge eat) should be assessed. Overall, research involving mindfulness should move away from using terminology such as "healthy" and "unhealthy" food as it is inconsistent with the non-judgment premise of mindfulness.

Finally, future studies should continue to investigate mechanisms of action in both brief mindfulness inductions and full-length MBTs for EDs to inform treatment development. The mechanisms of action in the brief mindfulness induction may be different from those in a full-length MBT. Attention redeployment (i.e., moving attention away from a distressing stimulus; Gross & Thompson, 2007) and decentering (ability to recognize and observe thoughts and emotions as temporary psychological events; Safran & Segal, 1990) should be tested as potential mechanisms of brief mindfulness interventions. Further, future studies should include physiological measures of stress and arousal (e.g., skin conductance, heart rate, temperature, etc.) to assess whether a physiological change may mediate the effect of mindfulness induction on ED symptoms and other outcomes. Reduced rumination, improved emotion regulation, and increased awareness of hunger, fullness, and satiety cues should be tested as mediators in treatment studies of MBT for EDs, because multiple mindfulness sessions may be needed to build these skills. Other potential mediators of MBTs for EDs, such as psychological flexibility and self-compassion, should be examined (Vanzhula & Levinson, 2020).

Conclusions

To my knowledge, this is the first study that compared the effects of the formal mindfulness practice (mindful breathing) and eating-focused mindfulness practice (mindful eating), and their combination on state ED symptoms and food intake. The findings revealed that brief mindfulness practices might be interchangeable short-term, with mindful breathing exercises having the most substantial effects. Mindful breathing practice outperformed the rest at improving awareness of hunger, fullness, and satiety cues and led to greater consumption of high-density foods overall and in participants who

experienced higher vs. lower levels of hunger. Individuals high in baseline ED symptoms benefited the most from a combination of mindful breathing and mindful eating. I was not able to make any conclusions about the mechanisms of action of brief mindfulness practices. This study provides preliminary evidence for the efficacy of mindfulness on ED symptoms, and I hope that its findings serve as a momentum for continued research on mindfulness in the treatment of EDs.

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Figure 1. Hypothesized model of mechanisms of action in MBTs for EDs.

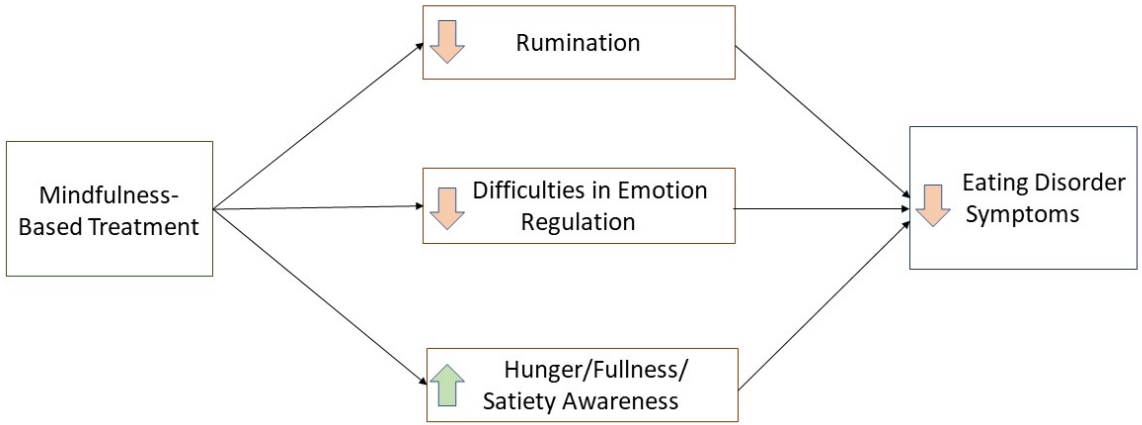


Figure 2. Study procedure.

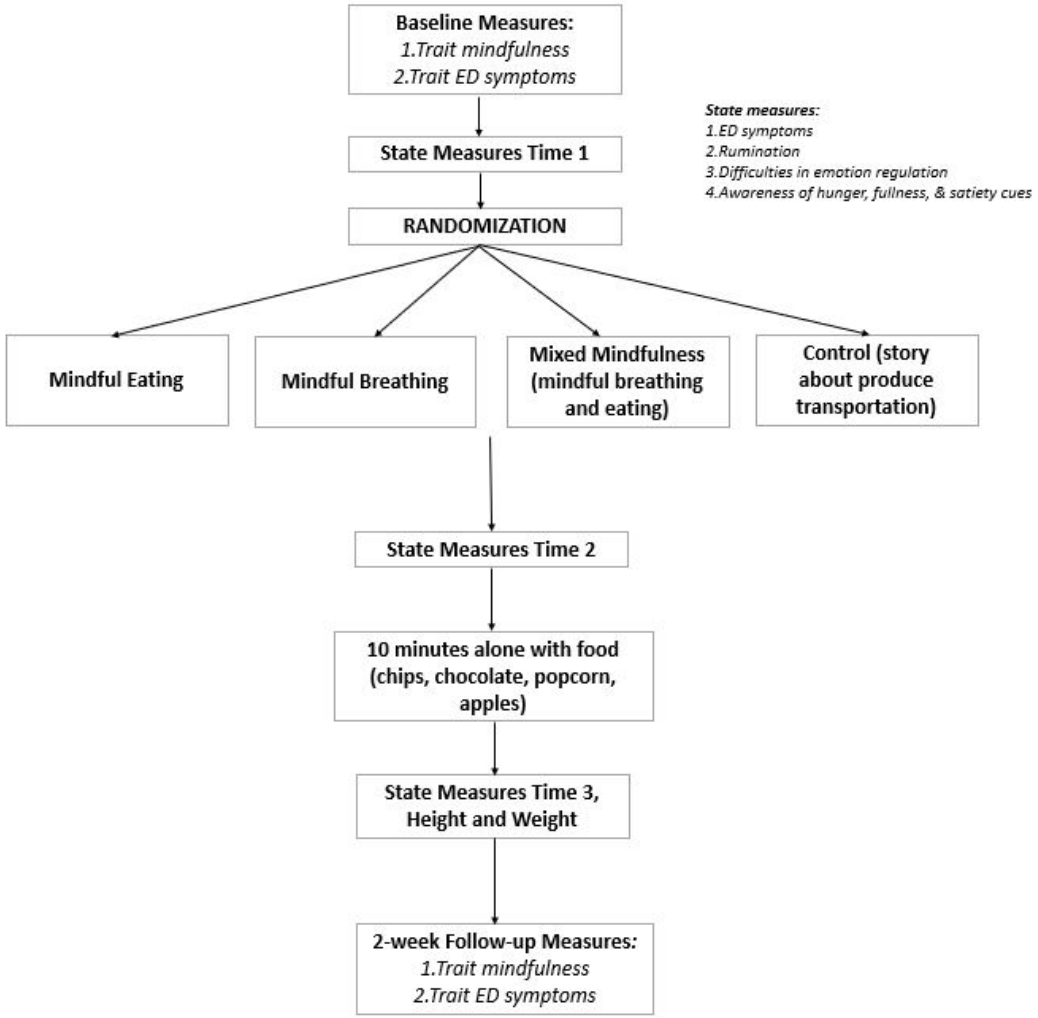


Table 1. Zero-order correlations across baseline and time 1 state measures.

	FFMQ	EDEQ	RTQ-S	EAS-S	SEDS	SMS	S-DERS	Total Food	Low-Density Food	High-Density Food
FFMQ	-	-.36**	-.55**	.20*	-.32**	.28**	-.62**	.02	.05	-.04
EDEQ		-	.27**	-.10	.81**	.04	.33**	-.08	-.06	-.11
RTQ-S			-	-.15	.30**	.03	.46**	-.14	-.18*	.09
EAS-S				-	-.18*	.19*	-.34**	.01	.01	-.03
SEDS					-	.07	.31**	-.01	.01	-.09
SMS						-	-.26**	-.11	-.09	-.03
S-DERS							-	-.02	-.04	.02
Total Food								-	.92**	.41**
Low-Density Food									-	.10
High-Density Food										-

Note: All state measures scores are listed at time 1; * $p < .05$; ** $p < .01$; FFMQ = Five Factor Mindfulness Questionnaire (trait mindfulness); EDEQ = Eating Disorder Examination Questionnaire (baseline ED symptoms); SMS = State mindfulness Scale; SEDS = State Eating Disorder Scale; S-DERS = State Difficulties in Emotion Regulation Scale; RTQ-S = Repetitive Thinking Scale – State; EAS-S = Eating Awareness Scale- State.

Table 2. Zero-order correlations between changes in outcome variables from time 1 to time 2 across conditions.

Mindful Eating					
	SMS_{chg}	$SEDS_{chg}$	$S\text{-}DERS_{chg}$	$RTQ\text{-}S_{chg}$	$EAS\text{-}S_{chg}$
SMS_{chg}	-	-.08	-.07	-.13	-.05
$SEDS_{chg}$		-	.19	**.44****	-.05
$S\text{-}DERS_{chg}$			-	**.47****	**.40***
$RTQ\text{-}S_{chg}$				-	.03
$EAS\text{-}S_{chg}$					-

Mindful Breathing					
	SMS_{chg}	$SEDS_{chg}$	$S\text{-}DERS_{chg}$	$RTQ\text{-}S_{chg}$	$EAS\text{-}S_{chg}$
SMS_{chg}	-	-.29	-.21	**-.39***	-.08
$SEDS_{chg}$		-	.11	**.35***	-.09
$S\text{-}DERS_{chg}$			-	**.34***	.06
$RTQ\text{-}S_{chg}$				-	-.07
$EAS\text{-}S_{chg}$					-

Mixed Mindfulness					
	SMS_{chg}	$SEDS_{chg}$	$S\text{-}DERS_{chg}$	$RTQ\text{-}S_{chg}$	$AHFS\text{-}S_{chg}$
SMS_{chg}	-	-.07	-.08	.25	.17
$SEDS_{chg}$		-	.27	.23	.03
$S\text{-}DERS_{chg}$			-	**.38***	.07
$RTQ\text{-}S_{chg}$				-	-.01
$EAS\text{-}S_{chg}$					-

Control					
	SMS_{chg}	$SEDS_{chg}$	$S\text{-}DERS_{chg}$	$RTQ\text{-}S_{chg}$	$AHFS\text{-}S_{chg}$
SMS_{chg}	-	.01	-.22	.02	-.10
$SEDS_{chg}$		-	.06	.01	-.18
$S\text{-}DERS_{chg}$			-	.26	**.47****
$RTQ\text{-}S_{chg}$				-	.19
$EAS\text{-}S_{chg}$					-

Note: * $p < .05$; ** $p < .01$; SMS_{chg} = State mindfulness scale score change from T1 to T2; $SEDS_{chg}$ = State eating disorder scale score change from T1 to T2; $S\text{-}DERS_{chg}$ = State difficulties in emotion regulation scale score change from T1 to T2; $RTQ\text{-}S_{chg}$ = Repetitive thinking scale (rumination) score change from T1 to T2; $EAS\text{-}S_{chg}$ = Eating Awareness Scale- State change from T1 to T2.

Table 3. Mean and standard deviation state mindfulness by study condition.

Condition	*n*	Time 1	Time 2	Change T1 to T2
Mindful Eating	37	49.48 (12.42)	53.53 (18.26)	2.97 (16.68)
Mindful Breathing	38	52. 16 (12.62)	58.98 (16.74)	9.26 (12.00)
Mixed Mindfulness	39	48.11 (16.46)	58.70 (15.22)	10.78 (12.50)
Control	37	43.43 (17.10)	38.26 (16.54)	-9.70 (13.42)
Total	152	49.86(12.48)	53.19(17.20)	

Note: Time 1 = Beginning of the experiment; Time 2 = Immediately after manipulation; Time 3 = After participants were left alone with food for 10 min.

Figure 3. Change in state mindfulness across study conditions.

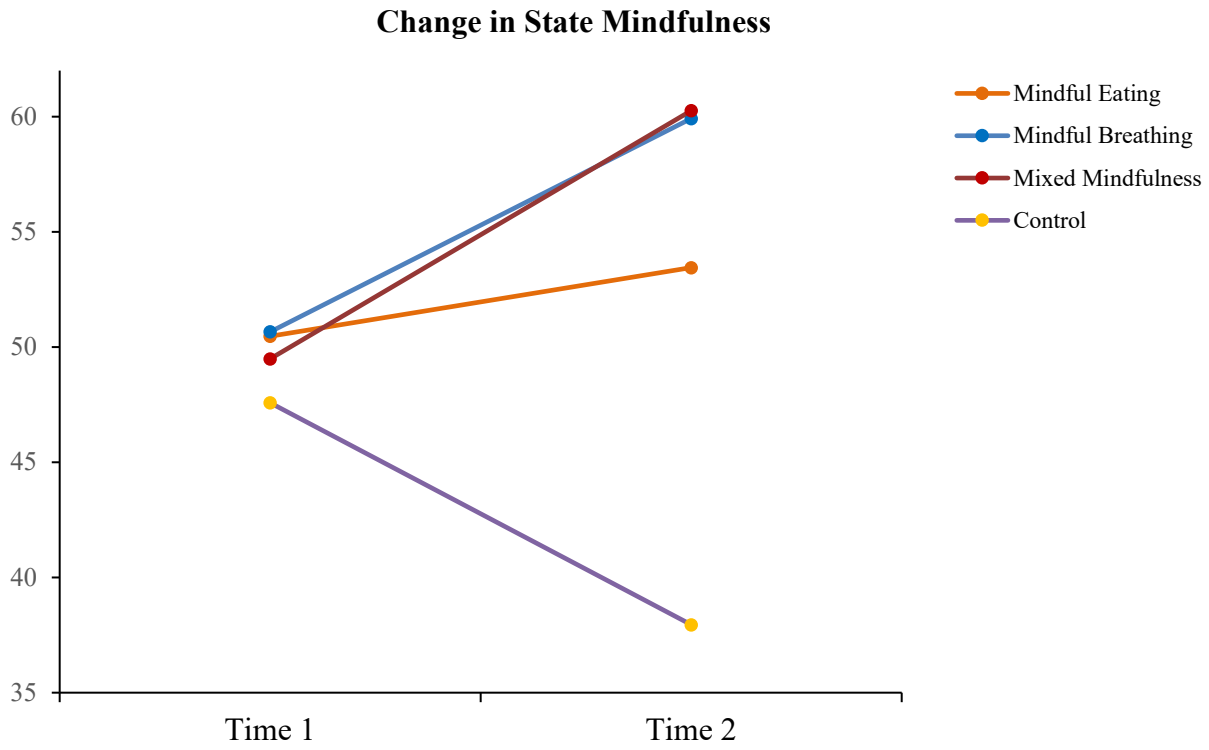


Table 4. Mean and standard deviation state eating disorder symptoms by study condition.

Condition	*n*	Time 1	Time 2	Time 3	Change T1 to T2
Mindful Eating	37	1.59 (1.19)	1.40 (1.12)	1.40 (1.12)	-.19(.34)
Mindful Breathing	38	1.65 (1.29)	1.30 (1.14)	1.36 (1.21)	-.32(.43)
Mixed Mindfulness	39	1.24 (1.14)	.96 (1.01)	1.03 (1.19)	-.33(.54)
Control	37	1.14 (1.10)	1.01 (1.11)	.91 (1.07)	-.15(.61)
Total	152	1.50(1.18)	1.25(1.09)	1.28 (1.17)	

Note: Time 1 = Beginning of the experiment; Time 2 = Immediately after manipulation; Time 3 = After participants were left alone with food for 10 min.

Figure 4. Change in state ED symptoms across study conditions.

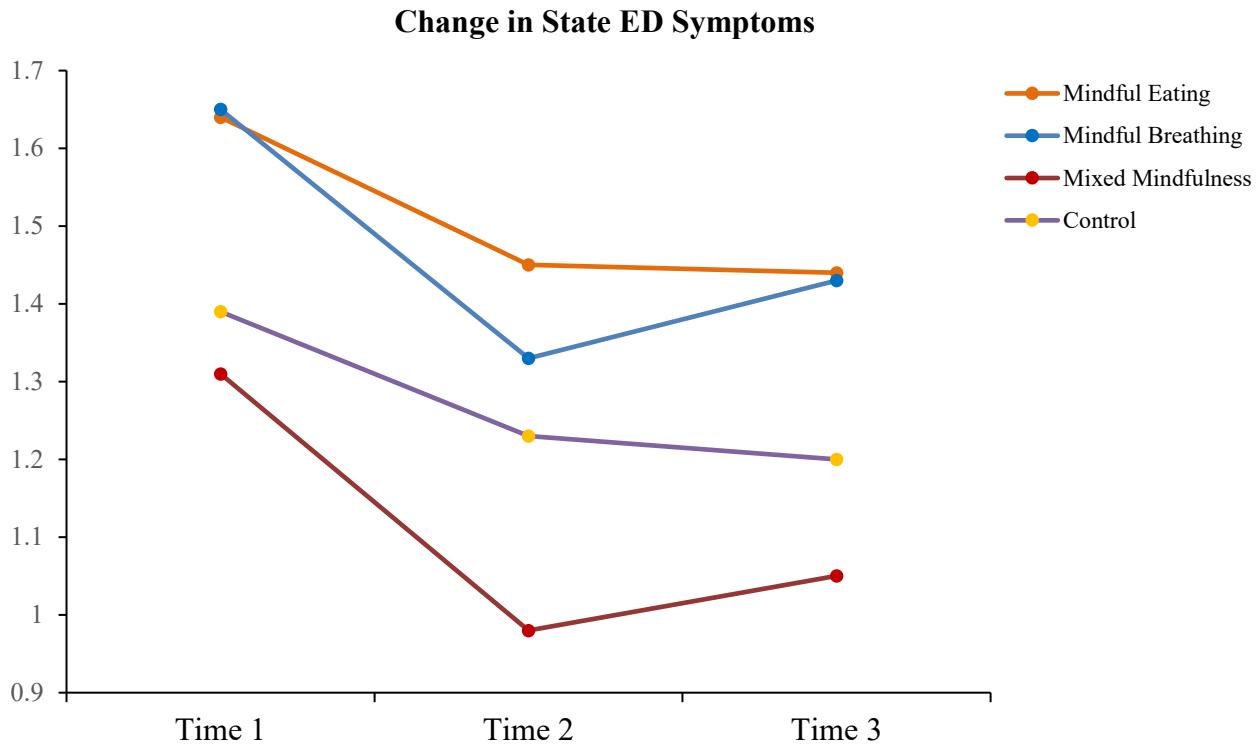


Table 5. Mean and standard deviation baseline eating disorder symptoms and trait mindfulness by study condition.

		Baseline ED		Trait Mindfulness	
Condition	*n*	Baseline	Follow-up (*n* = 109)	Baseline	Follow-up (*n* = 109)
Mindful Eating	37	1.99(1.27)	1.63(1.41)	3.27(.60)	3.54(59)
Mindful Breathing	38	1.79(1.24)	1.62(1.29)	3.00(.71)	3.24(.82)
Mixed Mindfulness	39	1.63(1.17)	1.55(1.34)	3.15(.65)	3.34(.88)
Control	37	1.68(1.44)	1.32(.93)	3.21(.55)	3.31(.55)
Total	152	1.77(1.28)	1.55(1.27)	3.16(.63)	3.29(.73)

Note. ED = Eating disorders.

Table 6. Mean and standard deviation of the amount of food consumed during the experiment by condition in ounces.

Condition	*n*	Apples	Popcorn	Chips	Chocolate	Total Food	Low-Density	High-Density
Mindful Eating	36	2.49 (1.83)	.18 (.17)	.41 (.36)	.42 (.45)	3.50 (2.17)	2.72 (1.95)	.82 (.69)
Mindful Breathing	37	3.22 (1.96)	.17 (.16)	.49 (.36)	.52 (.52)	4.39 (1.99)	3.48 (1.91)	.97 (.69)
Mixed Mindfulness	39	3.42 (2.06)	.11 (.16)	.31 (.38)	.38 (.44)	4.23 (2.29)	3.54 (2.07)	.69 (.68)
Control	36	3.62 (2.11)	.11 (.15)	.32 (.36)	.31 (.46)	4.37 (2.21)	3.82 (2.02)	.59 (.60)

Note. Three individuals were excluded from this analysis because they were allergic to foods provided in the study.

Figure 5. Interaction between the effects of hunger and study conditions on high-density food intake.

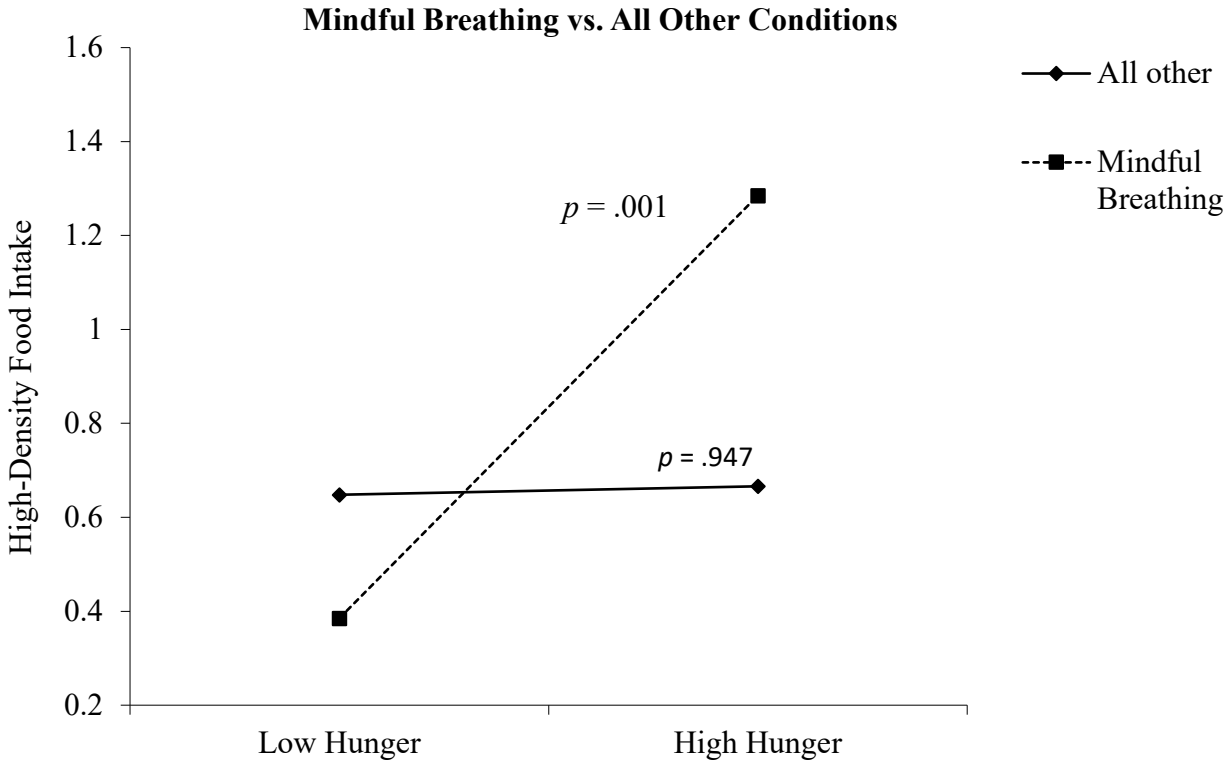


Figure 6. Interaction between the effects of hunger and study conditions on high-density food intake.

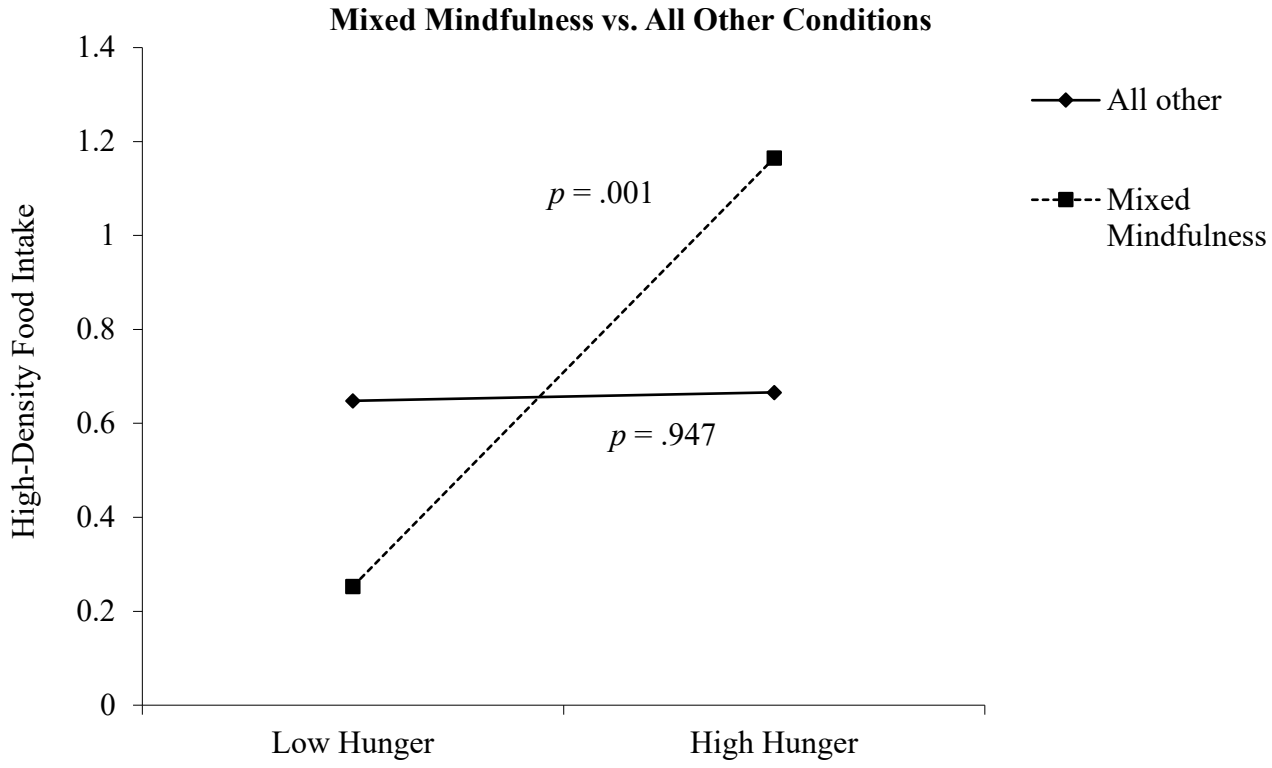
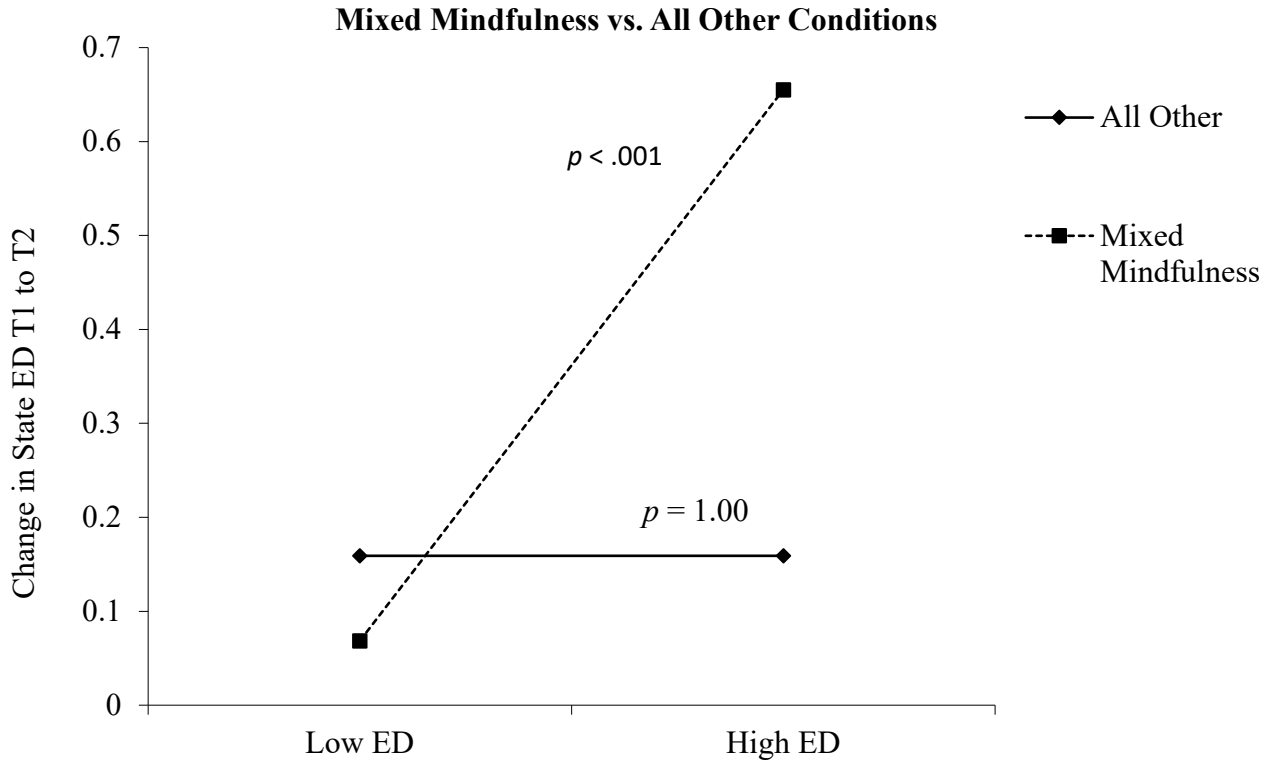


Table 7. Interaction between the effects of hunger and study conditions on high-density food intake.

Model		*β*	Std. Error	*t*-value	Part *r*	*p*-value	*F*	*df*	*p*	R^2
	Overall model						5.54	7,140	< .001	.22
	Constant	-	.19	3.31	-	.001				
	Condition 1	-.23	.26	-.95	-.07	.342				
	Condition 2	-.39	.29	-1.43	-.11	.156				
	Condition 3	-.53	.26	-2.13	-.16	.035				
	Hunger	-.02	.04	-.10	-.01	.917				
	Hunger*Condition 1	.42	.06	1.72	.13	.089				
	Hunger*Condition 2	.68	.06	2.38	.18	.019				
	Hunger*Condition 3	.66	.06	2.63	.20	.009				

Note: ED = Eating disorders; Condition 1 = Dummy coded variable (mindful eating = 1, all other conditions – 0); Condition 2 = Dummy coded variable (mindful breathing = 1, all other conditions – 0); Condition 3 = Dummy coded variable (mixed mindfulness = 1, all other conditions – 0).

Figure 7. Interaction between the effects of baseline ED symptoms and study conditions on change in state ED symptoms.



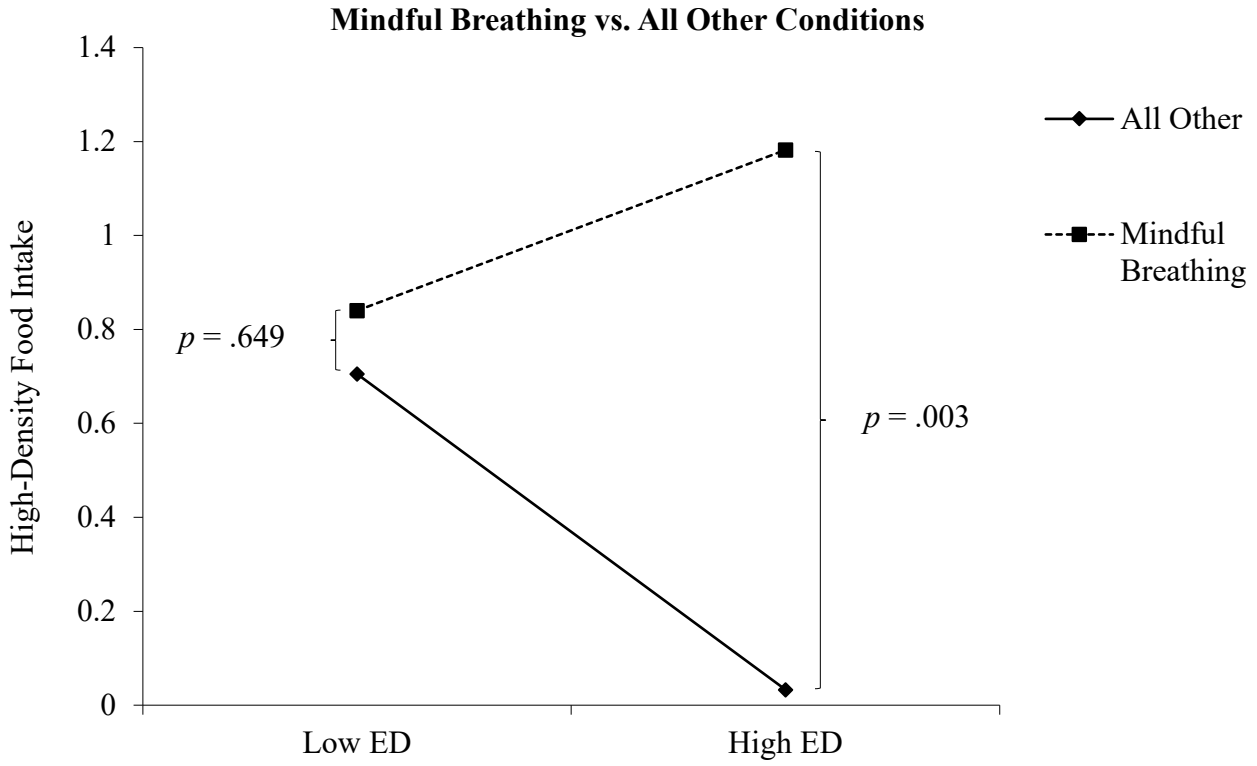
Note. ED = Eating disorders.

Table 8. Interaction between the effects of baseline ED symptoms and condition on change in state ED symptoms.

Model		β	Std. Error	*t*-value	Part *r*	*p*-value	*F*	*df*	*p*	R^2
	Overall model						5.54	7,140	< .001	.22
	Constant	-	.12	1.39	-	.165				
	Condition 1	-.01	.19	-.05	-.01	.963				
	Condition 2	-.03	.18	-.21	-.02	.834				
	Condition 3	-.19	.18	-1.21	-.10	.228				
	Baseline ED	-.04	.06	-.26	-.02	.792				
	Baseline ED *Condition 1	.06	.09	.36	.03	.720				
	Baseline ED *Condition 2	.26	.09	1.52	.12	.131				
	Baseline ED *Condition 3	.46	.09	2.82	.22	.005				

Note: ED = Eating disorders; Condition 1 = Dummy coded variable (mindful eating = 1, all other conditions – 0); Condition 2 = Dummy coded variable (mindful breathing = 1, all other conditions – 0); Condition 3 = Dummy coded variable (mixed mindfulness = 1, all other conditions – 0).

Figure 8. Interaction between the effects of baseline ED symptoms and study conditions on high-density food intake.



Note: ED = Eating disorders.

Table 9. Interaction between the effects of baseline ED symptoms and study conditions on high-density food intake.

Model		*β*	Std. Error	*t*-value	Part *r*	*p*-value	*F*	*df*	*p*	R^2
	Overall model						2.35	7,141	.027	.10
	Constant	-	.11	7.19	-	< .001				
	Condition 1	.03	.18	.17	.01	.864				
	Condition 2	-.03	.17	-.18	-.02	.844				
	Condition 3	.08	.17	.47	.04	.642				
	Baseline ED	-.31	.05	-2.12	-.17	.036				
	Baseline ED *Condition 1	.17	.08	.97	.08	.333				
	Baseline ED *Condition 2	.37	.08	2.13	.17	.035				
	Baseline ED *Condition 3	-.02	.08	-.14	-.01	.886				

Note: Condition 1 = Dummy coded variable (mindful eating = 1, all other conditions – 0); Condition 2 = Dummy coded variable (mindful breathing = 1, all other conditions – 0); Condition 3 = Dummy coded variable (mixed mindfulness = 1, all other conditions – 0).

Table 10. State rumination mean and standard deviation of by condition.

Condition	*n*	Time 1	Time 2	Time 3	Change T1 to T2
Mindful Eating	37	22.16(11.06)	18.11(9.71)	17.53(10.16)	-4.05(7.64)
Mindful Breathing	38	27.16(12.36)	18.82(9.72)	18.13(9.36)	-8.34(10.00)
Mixed Mindfulness	39	22.95(11.06)	18.08(9.85)	17.82(9.60)	-4.87(9.78)
Control	37	26.97(9.85)	21.51(9.23)	19.78(9.68)	-5.46(7.52)
Total	152	24.78(11.25)	19.11(9.64)	18.30(9.65)	

Note: Time 1 = Beginning of the experiment; Time 2 = Immediately after manipulation; Time 3 = After participants were left alone with food for 10 min.

Figure 9. Change in state rumination symptoms across study conditions.

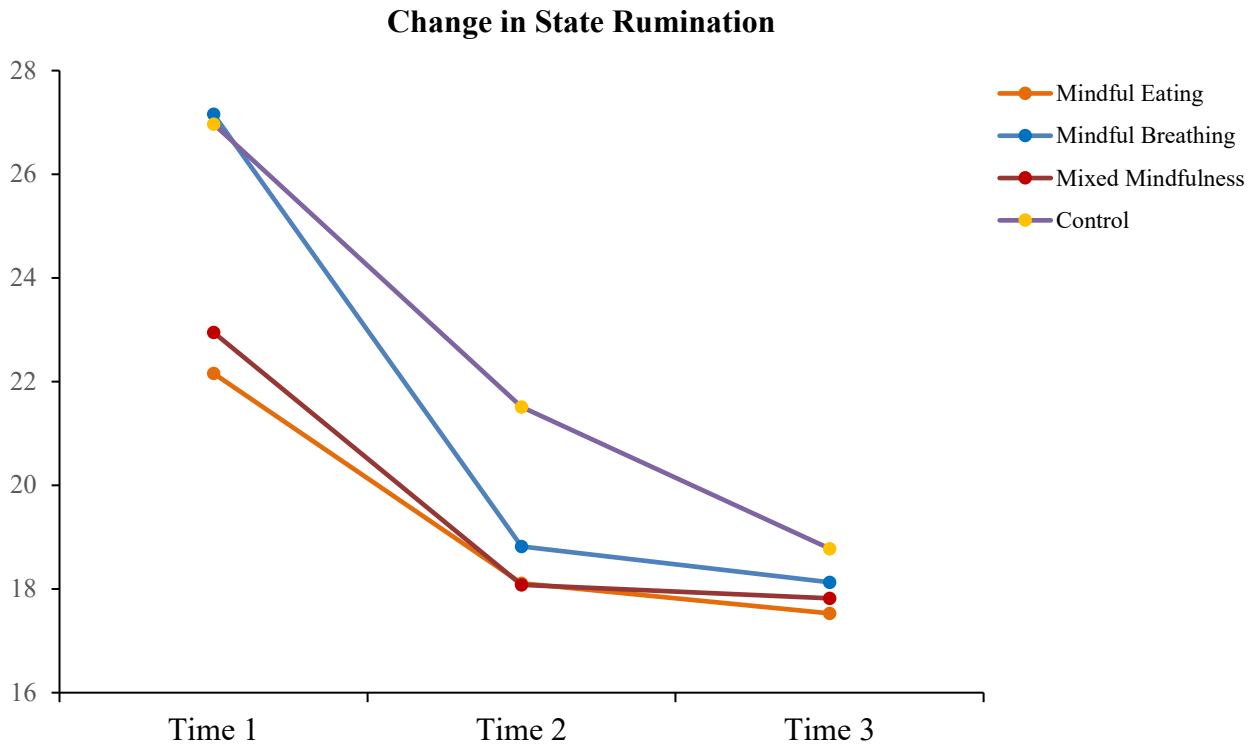


Table 11. Mean and standard deviation state difficulties in emotion regulation by condition.

Condition	*n*	Time 1	Time 2	Time 3	Change T1 to T2
Mindful Eating	37	37.13(11.61)	35.58(10.43)	34.58(11.00)	-1.55(8.28)
Mindful Breathing	38	42.79(15.40)	39.05(12.22)	37.63(13.55)	-3.74(8.73)
Mixed Mindfulness	39	39.23(15.64)	34.85(11.16)	34.00(10.97)	-4.38(10.70)
Control	37	38.54(13.06)	35.14(9.17)	34.95(11.98)	-3.40(9.48)
Total	152	39.43(14.06)	36.15(10.84)	35.28(11.88)	

Note: Time 1 = Beginning of the experiment; Time 2 = Immediately after manipulation; Time 3 = After participants were left alone with food for 10 min.

Figure 10. Change in state difficulties in emotion regulation across study conditions.

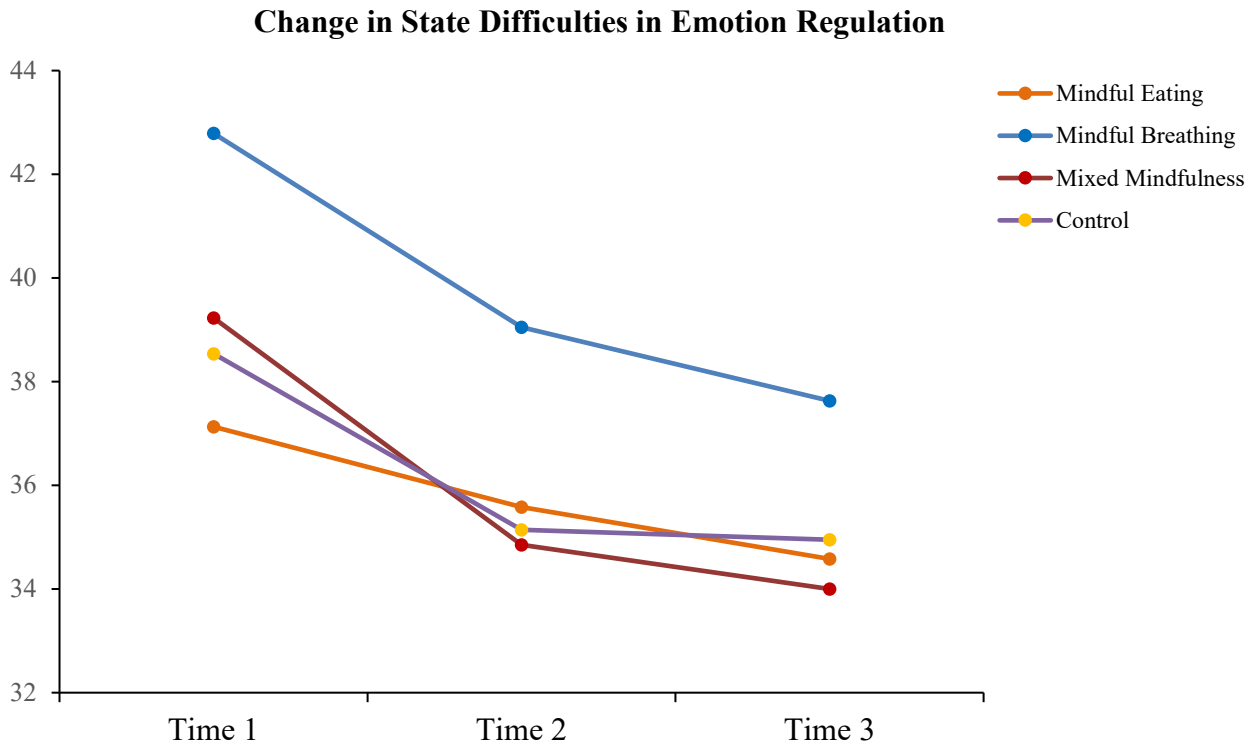


Table 12. Mean and standard deviation state awareness of hunger, fullness, and satiety cues by condition.

Condition	*n*	Time 1	Time 2	Time 3	Change T1 to T1
Mindful Eating	37	30.66(9.47)	33.92(7.99)	34.47(8.32)	3.26(6.41)
Mindful Breathing	38	28.13(7.45)	31.58(7.79)	32.82(9.30)	3.44(4.14)
Mixed Mindfulness	39	32.00(8.21)	34.59(6.49)	34.82(7.15)	2.58(5.31)
Control	37	28.73(9.40)	30.14(9.55)	31.41(9.23)	1.40(3.39)
Total	152	29.90(8.72)	32.59(8.13)	33.40(8.55)	

Note: Time 1 = Beginning of the experiment; Time 2 = Immediately after manipulation; Time 3 = After participants were left alone with food for 10 min.

Figure 11. Change in state difficulties in awareness of hunger, fullness, and satiety cues across study conditions.

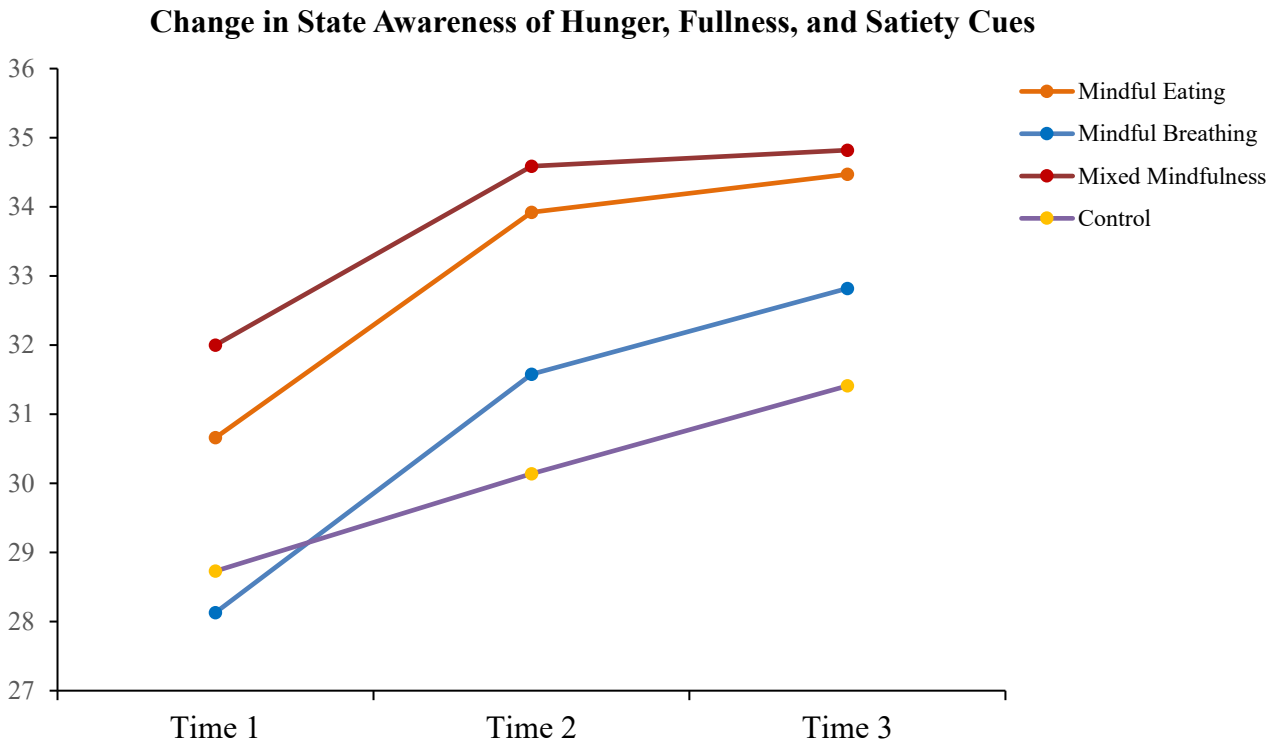
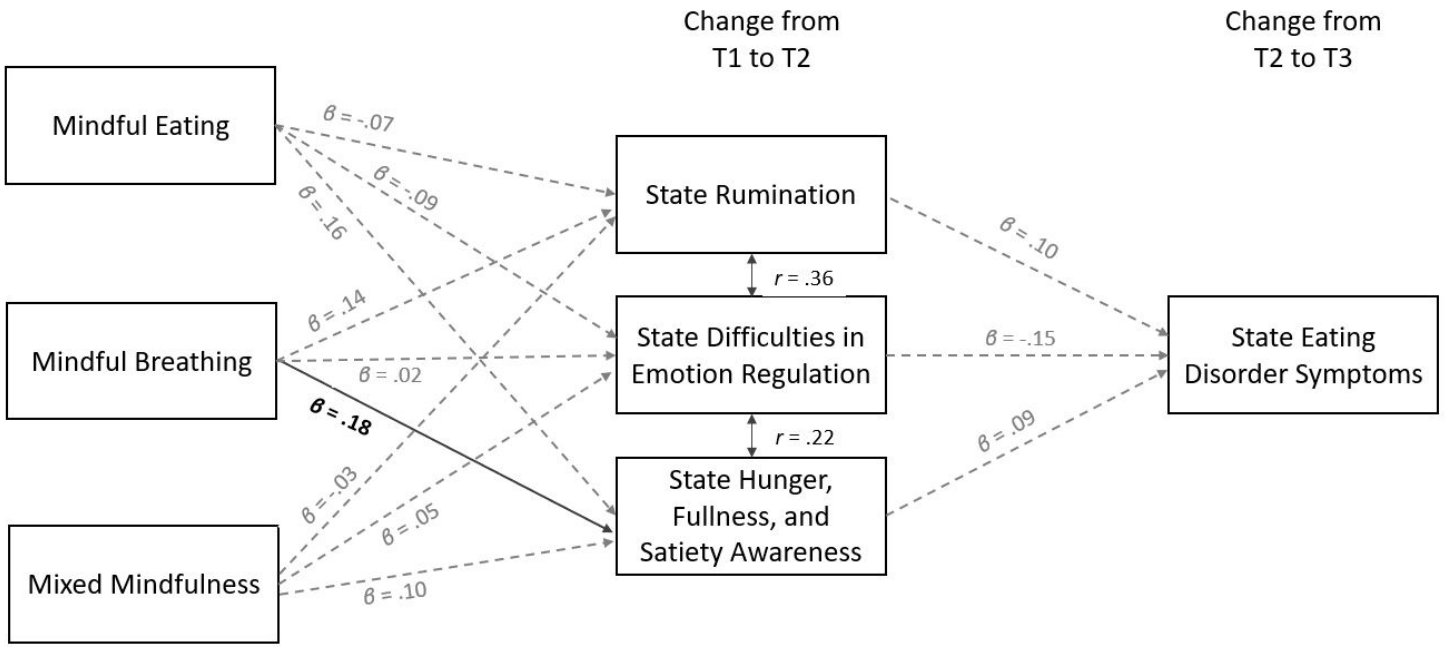
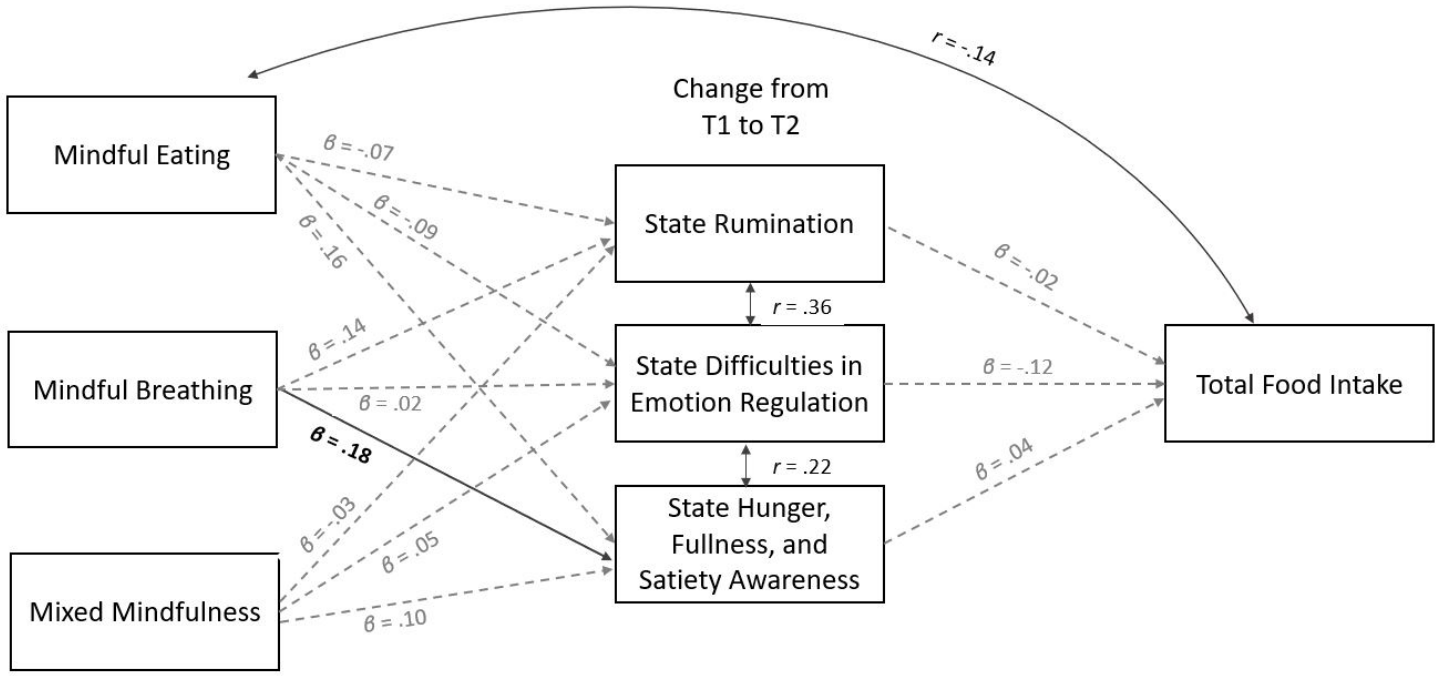


Figure 12. Model of indirect effects of changes in rumination, awareness of hunger, fullness, and satiety cues, and difficulties in emotion regulation between time 1 and time 2 on change in state ED symptoms from time 2 to time 3.



Note: Solid lines indicate significant paths at $p < .05$. Dashed lines indicate non-significant paths.

Figure 13. Model of indirect effects of changes in rumination, awareness of hunger, fullness, and satiety cues, and difficulties in emotion regulation between time 1 and time 2 on total food intake.



Note: Solid lines indicate significant paths at $p < .05$. Dashed lines indicate non-significant paths.

APPENDICES

Appendix 1. Scripts for experimental conditions.

Condition One: Raisin Exercise

We are going to do an exercise of experiencing a food object mindfully. What we would like you to do is to see it as an object, as if you had dropped in from another planet and you had never seen anything like this before in your life…

Take one raisin and hold it in the palm of your hand or between your finger and thumb... Looking at it with curiosity as if you have never seen one before… Realizing you never actually have seen this particular raisin before…

Pay attention to seeing it… Turning it over between your fingers … Exploring its texture between your fingers … Examining its color, the highlights where the light shines … the darker hollows and folds. Let your eyes explore every part of it…

And if while you are doing this, any thoughts come to mind about "what a strange thing we are doing" or "what's the point of this" or "I don't like this," then just notice them as thoughts and bring your awareness back to the food object…

Now closing your eyes and bringing the raising underneath your nose and smelling it, seeing what you notice. Being aware of any thoughts or memories the smell brings to mind… Noticing how easy our mind brings up the images…

Now keeping your eyes closed bring it to your mouth, may be noticing how your hand and arm know exactly where to put it… perhaps noticing what happens in your mouth as it comes up…. Feeling it against the outside of your lips and noticing what that feels like … Being aware of any thoughts or feelings that come up about raisins…

With your eyes still closed, placing it in your mouth, but do not chew it yet. Noticing how it feels in your mouth. Moving it around in your mouth and noticing the sensations… Exploring the raisin with your tongue, noticing the sensations as you move it around in the mouth…

And when you are ready, very consciously taking a bite into it and noticing what happens … the taste that it releases… Slowly chewing it … noticing what is happening in your mouth … the change in consistency of the object…

Very slowly chewing it, experiencing the flavor, the feel… Resisting the urge to swallow it… Where in your mouth are you chewing it? Now again noticing any thoughts or feelings about eating this raisin…

Now as you are getting ready to swallow it, noticing the experience of the impulse to swallow. What is that like? ... And swallowing when you are ready… Seeing if you can follow the sensations of swallowing it, sensations of it moving down to your stomach, any aftertaste… Be aware of these reactions, in your body, in your mouth… then noticing absence of the raisin in the mouth, and what the tongue does when it's gone… Realizing you have now taken in the energy of one raisin…

Now opening your eyes, pick up the second raisin… Again, examine it… Turning it over between your fingers… Examining its color and texture… Let your eyes explore every part of it… Notice how it may be different from the first raisin…

And now closing your eyes, bring it up to your nose and smelling it… Has anything changed?

Be aware of whatever thoughts and feelings are now coming up...

Placing it in your mouth, and again, watching the experience of this raisin first without chewing…

Then begin chewing slowly… observing the taste, the texture… Notice any similarities or differences with the first raisin… Again, resisting the impulse to swallow…

When you are ready to swallow, do so, noticing the point of swallowing when you can no longer feel the raisin going down the back of your throat…

Now opening your eyes and looking at the third raisin… Notice any thoughts you may have about eating or not eating the third raisin…

Now pick up the third raisin and lead yourself through examining, smelling, eating and savoring this raisin mindfully…

If your mind is getting distracted, it's okay, just bring your attention back to the raisin and continue to explore its texture, smell and taste…

As you finish with the third raisin, what are you aware of?... Consider what you know about raisins and how this little piece of food energy came from where it was first planted and grown, to where you are now… being appreciative of all the people involved in having that happen….

Condition Two: Mindful Breathing

We invite you to participate in a focused breathing exercise.

Settle into a comfortable sitting position on the chair. Allow your back to adopt an erect, dignified, and comfortable posture. Place your feet flat on the floor, with your legs uncrossed and your hands in your lap or on the armrests. You may imagine a string tied to the top of your head gently elongating the spine pulling up to the ceiling, to give you a sense of alert presence.

Bring your awareness to the level of physical sensations by focusing your attention on the sensations of touch and pressure in your body where it makes contact with the floor and whatever you are sitting on…

You will notice that the breath is already happening in the body, the breath is breathing itself… We are going to begin by simply bring attention to the sensations of the breath… Different people experience the breath more strongly in different parts of the body, you may sense it in the belly as the belly rises and falls with each inhale and exhale… Or perhaps at the tip of the nose where the air enters somewhat cooler and leaves a little warmer… You may even notice the breath in the chest, as it enters and leaves the lungs, or in your shoulders as they are rising and falling. See in which one if these areas it is most easy to sense the breath, and begin to follow the sensations of the breath there…

See if you can follow the breath through its full cycle, from the beginning of an inhale, the air flowing into your chest and your stomach, back out to the end of the exhale, and then onto the next cycle…

There is no need to try to control the breathing in any way… simply let the breath breathe itself. There is nothing to be fixed, no particular state to be achieved…. As best you can, simply allow your experience to be your experience, without needing it to be anything special…

Sooner or later, your mind will wander away from the focus on the breath to thoughts, planning, daydreams, drifting along… This is perfectly OK, it is the nature of the mind, its simply what minds do… It is not a mistake or a failure… When you notice that your awareness is no longer on the breath, simply allow the thoughts to arise and to pass… Like clouds passing through the sky… Then, gently escort the awareness back to a focus on the breath, and continue to watch your breath…

However often you notice that the mind has wandered (and this will likely happen over and over and over again), as best you can, congratulate yourself each time on reconnecting with your experience in the moment, gently escorting the attention back to the sensations of the breath, You may want to acknowledge briefly where the mind has been (“Ah, there’s thinking”)…

Continue to follow the breath and feel it through its full cycle… (pause) Perhaps generating an attitude of interest or curiosity in the moment to moment texture, rhythm, and sensation of each inbreath and each outbreath…

Again and again returning to the sensation of breath in this moment however it presents itself. As if there was nowhere else to go, nothing else to do, simply this moment…

As you continue, you will notice that the mind will become caught up with thoughts and feelings. It may become attached to noises or bodily sensations. You may find yourself remembering something from your past, thinking about the future, or flowing into fantasy. This is to be expected. This is the nature of the mind… When you notice this, without self-judgment, simply observe the process of the mind, then return your attention to the breath. Simply ride with the flow of breath, feeling it move in and out, freely shifting with a gentle, natural rhythm…

Once again see if its possible to follow the breath through its full cycle, from beginning to inhale to the end of the exhale and on to the next… Allow thoughts, images, and bodily sensations if they arise in the mind, just to arise and to pass on their own, gently and lovingly returning the attention to the breath…

No need to push away thoughts, irritation, discomfort out of your mind. Simply be patient with yourself and with your body. Notice the experience of the busy mind, of emotional ups and downs, or of boredom. Then let go of whatever tries to capture your attention. Return your attention back to the breath.

As we are going to finish the practice, follow your current breath cycle to the outbreath, stretch a little, wiggle your fingers and toes, and open your eyes… Notice how it feels to be in your body right now…

Condition Three Version One: Mindful Breathing and Eating

We invite you to participate in a focused breathing exercise.

Settle into a comfortable sitting position on the chair. Allow your back to adopt an erect, dignified, and comfortable posture. Place your feet flat on the floor, with your legs uncrossed and your hands in your lap or on the armrests … Gently close your eyes…

Bring your awareness to the level of physical sensations by focusing your attention on the sensations of touch and pressure in your body where it makes contact with the floor and whatever you are sitting on…

You will notice that the breath is already happening in the body… Different people experience the breath more strongly in different parts of the body: you may sense it in the belly as the belly rises and falls with each inhale and exhale… Or perhaps at the tip of the nose where the air enters somewhat cooler and leaves a little warmer. You may even notice the breath in the chest, as it enters and leaves the lungs, or in your shoulders as they are rising and falling… See in which one if these areas it is most easy to sense the breath, and begin to follow the sensations of the breath there…

See if you can follow the breath through its full cycle, from the beginning of an inhale, the air flowing into your chest and your stomach, back out to the end of the exhale, and then onto the next cycle…

Sooner or later, your mind will wander away from the focus on the breath to thoughts, planning, daydreams, drifting along… This is perfectly OK, it is the nature of the mind, its simply what minds do. When you notice that your awareness is no longer on the breath, simply allow the thoughts to arise and to pass… Like clouds passing through the sky… Then, gently escort the awareness back to a focus on the breath, and continue to watch your breath…

However often you notice that the mind has wandered (and this will likely happen over and over and over again) congratulate yourself each time on reconnecting with your experience in the moment, gently escorting the attention back to the sensations of the breath, You may want to acknowledge briefly where the mind has been such as ("Ah, there's that thought again")…

Continue to follow the breath and feel it through its full cycle… Perhaps generating an attitude of interest or curiosity in the moment to moment texture, rhythm, and sensation of each inbreath and each outbreath…

Now follow your current breath cycle to the outbreath, stretch a little … wiggle your fingers and toes … and open your eyes… Notice how it feels to be in your body right now…

…

Next, we are going to an exercise of experiencing a food object mindfully. What we would like you to do is to see it as an object, as if you had dropped in from another planet and you had never seen anything like this before in your life…

Take one raisin and hold it in the palm of your hand or between your finger and thumb… Looking at it with curiosity as if you have never seen one before. Realizing you never actually have seen this particular raisin before…

Pay attention to seeing it… Turning it over between your fingers … Exploring its texture between your fingers … Examining its color, the highlights where the light shines … the darker hollows and folds. Let your eyes explore every part of it…

And if while you are doing this, any thoughts come to mind about "what a strange thing we are doing" or "what's the point of this" or "I don't like this," then just notice them as thoughts and bring your awareness back to the food object…

Now closing your eyes and bringing the raising underneath your nose and smelling it, seeing what you notice. Being aware of any thoughts or memories the smell brings to mind… Noticing how easy our mind brings up the images…

Now keeping your eyes closed bring it to your mouth, may be noticing how your hand and arm know exactly where to put it… perhaps noticing what happens in your mouth as it comes up…. Feeling it against the outside of your lips and noticing what that feels like … Being aware of any thoughts or feelings that come up about raisins…

With your eyes still closed, placing it in your mouth, but do not chew it yet. Noticing how it feels in your mouth. Moving it around in your mouth and noticing the sensations… Exploring the raisin with your tongue, noticing the sensations as you move it around in the mouth…

And when you are ready, very consciously taking a bite into it and noticing what happens … the taste that it releases. Slowly chewing it … noticing what is happening in your mouth … the change in consistency of the object…

Now as you are getting ready to swallow it, noticing the experience of the impulse to swallow. What is that like? And swallowing when you are ready… Seeing if you can follow the sensations of swallowing it, sensations of it moving down to your stomach, any aftertaste… Be aware of these reactions, in your body, in your mouth… then noticing absence of the raisin in the mouth, and what the tongue does when it's gone. Realizing you have now taken in the energy of one raisin…

Condition Three Version Two: Mindful Eating and Breathing

We are going to an exercise of experiencing a food object mindfully. What we would like you to do is to see it as an object, as if you had dropped in from another planet and you had never seen anything like this before in your life…

Take one raisin and hold it in the palm of your hand or between your finger and thumb… Looking at it with curiosity as if you have never seen one before… Realizing you never actually have seen this particular raisin before…

Pay attention to seeing it… Turning it over between your fingers … Exploring its texture between your fingers … Examining its color, the highlights where the light shines … the darker hollows and folds. Let your eyes explore every part of it…

And if while you are doing this, any thoughts come to mind about "what a strange thing we are doing" or "what's the point of this" or "I don't like this," then just notice them as thoughts and bring your awareness back to the food object…

Now closing your eyes and bringing the raising underneath your nose and smelling it, seeing what you notice… Being aware of any thoughts or memories the smell brings to mind… Noticing how easy our mind brings up the images…

Now keeping your eyes closed bring it to your mouth, may be noticing how your hand and arm know exactly where to put it… perhaps noticing what happens in your mouth as it comes up… Feeling it against the outside of your lips and noticing what that feels like … Being aware of any thoughts or feelings that come up about raisins…

With your eyes still closed, placing it in your mouth, but do not chew it yet… Noticing how it feels in your mouth. Moving it around in your mouth and noticing the sensations… Exploring the raisin with your tongue, noticing the sensations as you move it around in the mouth…

And when you are ready, very consciously taking a bite into it and noticing what happens … the taste that it releases. Slowly chewing it … noticing what is happening in your mouth … the change in consistency of the object…

Now as you are getting ready to swallow it, noticing the experience of the impulse to swallow. What is that like? ... And swallowing when you are ready… Seeing if you can follow the sensations of swallowing it, sensations of it moving down to your stomach, any aftertaste… Be aware of these reactions, in your body, in your mouth… then noticing absence of the raisin in the mouth, and what the tongue does when it's gone… Realizing you have now taken in the energy of one raisin…

…

We now invite you to participate in a focused breathing exercise.

Settle into a comfortable sitting position on the chair. Allow your back to adopt an erect, dignified, and comfortable posture. Place your feet flat on the floor, with your legs uncrossed and your hands in your lap or on the armrests … Gently close your eyes…

Bring your awareness to the level of physical sensations by focusing your attention on the sensations of touch and pressure in your body where it makes contact with the floor and whatever you are sitting on…

You will notice that the breath is already happening in the body… Different people experience the breath more strongly in different parts of the body: you may sense it in the belly as the belly rises and falls with each inhale and exhale… Or perhaps at the tip of the nose where the air enters somewhat cooler and leaves a little warmer. You may even notice the breath in the chest, as it enters and leaves the lungs, or in your shoulders as they are rising and falling… See in which one if these areas it is most easy to sense the breath, and begin to follow the sensations of the breath there…

See if you can follow the breath through its full cycle, from the beginning of an inhale, the air flowing into your chest and your stomach, back out to the end of the exhale, and then onto the next cycle…

Sooner or later, your mind will wander away from the focus on the breath to thoughts, planning, daydreams, drifting along… This is perfectly OK, it is the nature of the mind, its simply what minds do. When you notice that your awareness is no longer on the breath, simply allow the thoughts to arise and to pass… Like clouds passing through the sky… Then, gently escort the awareness back to a focus on the breath, and continue to watch your breath…

However often you notice that the mind has wandered (and this will likely happen over and over and over again) congratulate yourself each time on reconnecting with your experience in the moment, gently escorting the attention back to the sensations of the breath, You may want to acknowledge briefly where the mind has been such as ("Ah, there's that thought again")…

Continue to follow the breath and feel it through its full cycle… Perhaps generating an attitude of interest or curiosity in the moment to moment texture, rhythm, and sensation of each inbreath and each outbreath…

Now follow your current breath cycle to the outbreath, stretch a little … wiggle your fingers and toes … and open your eyes… Notice how it feels to be in your body right now…

Condition Four: Neutral Food Script

You are going to hear a story about how produce makes its way from where it's grown to the local grocery stores. While you are listening, simply think about whatever comes to mind. Let your mind wander freely without trying to focus on anything in particular.

There's an excellent chance that you purchase most of your fruits and vegetables from the local grocery store, particularly in the winter months. Although your supermarket may be a couple of blocks or miles from your home, the fruits and vegetables most likely came from a farm hundred or even thousands of miles away. The process of growing and transporting high-quality organic produce requires a high level of effort, and coordination and some luck. We'll explore the entire process from planting to shipping so you can understand how groceries, fruits and vegetables stay fresh even days after you purchased them from the store.

In organic farms, having the right type of soil that is nutrient-rich is a major step to growing high-quality produce. The soil needs to be rich in nutrients such as phosphorus, nitrogen potassium and other micronutrients. It also needs to be alive with microorganisms that will allow the nutrients to be usable by plants. To maintain the rich soil that is ideal for fresh produce, farmers use a variety of techniques, including planting cover crops on the farm in the off-season and tilling natural compost into the soil.

The process of planting crops in farms has some complex aspects to it and also requires some sophisticated technology. Technology like laser leveling is used to tilt beds in the farm to maximize drainage; GPS technology is also used to ensure that rows of seeds remain even while providing efficient placement of irrigation systems. A few weeks after the soil has been tilled, and the beds are ready for planting, machines plant seeds into the soil.

Once the seeds have been sowed, the growing cycle begins and lasts anywhere from three to six weeks (depending on the crop). During this time, the plants are nurtured and taken care of consistently. Even though soil preparation is an important part of the process, nurturing processes like irrigation are a crucial part of growing high-quality crops. The well-cultivated baby greens are protected from pests and weeds either by using safe herbicides and pesticides or utilizing cover crops and drip irrigation systems to keep weeds at bay. Depending on where the crops are grown and the season, as well as the effectiveness of the protection methods, the baby greens could take anywhere from 21 days to 45 days to grow to complete maturity.

When the planted crops are ready to be harvested, farmers consider both timing and temperature. Some vegetables need to be harvested before it gets too hot and their leaves become too soft to pick. Groups of people work with picking machinery, such as harvesters. They drive the machine and steer it, putting the mechanically picked greens into storage containers like plastic totes. These baby greens are then stored under certain temperatures. Lettuce, for example, needs its leaves to stay in a 38ºF cold chain from the time of processing until they are bought at the stores by consumers. This is done to

maximize the edible lifespan of the greens, which is approximately 21 days from harvest to degradation.

Once trucks arrive from the field with picked leaves, a quality assurance specialist inspects the leaves in each of the totes to decide whether the produce is acceptable. If approved, the totes, filled with the vegetables, are sent to a processing facility where they are washed. Some large farms could process over 2 million baby greens on a weekly basis. Employees who work at the beginning of wash lines sort through the recently arrived fresh veggies to identify for unwanted parts and impurities such as roots and leaf clumps. Then, the fresh produce is sent into to be washed in chlorinated water, cleaning them of impurities to help extend the shelf life.

The greens are then placed in plastic bags that have different permeability levels, depending on the needs of the particular leaves. Spinach, for example, requires plenty of oxygen. As a result, the spinach bags have more permeability when compared to bags utilized for other vegetables. At regular time intervals, samples are inspected from processing lines by quality-control specialists. They take a good look at important characteristics, such as the temperature, quality of the product and the quantity of air in the bags. When they've been placed into packages, baby greens are transported to a storage area where they will eventually be picked up and transported to grocery stores.

Carriers, who are contracted to drive their refrigerated trucks to the processing facility, handle a significant amount of the delivery of produce from farms. Farms usually have regulations in place to ensure that fresh produce is promptly picked up from the facility. If things don't go as scheduled, and fresh produce is still sitting in the facility close to the end of its edible lifespan. When this occurs, the produce is either tilled into the ground or donated. Restaurants and grocery stores schedule pick up or delivery of produce from the distribution centers, usually within a day of its arrival.

During fresh produce transportation, there is a delicate balance between time and temperature. If the proper proportion is not maintained, inventory shelf life decreases. Controlling and monitoring temperature is crucial during the entire transportation process. Trailers should be pre-cooled prior to loading, during loading, and during transportation. Transportation cost have the greatest impact on the cost of the fresh produce due to limited processing required. Fresh produce prices are greatly impacted by fluctuating fuel costs. To remain competitive, local growers must identify transportation providers with optimized distribution networks that can assist in lowering total handling costs.

The appearance of fresh groceries on your dinner table is the culmination of their long journey through both natural and technological environments, as well as the hard work of lots of farm workers. With all the processing and transportation over, these groceries are now ready to be enjoyed at the dinner table.

Appendix 2. State measures.

State Eating Disorder Symptom Survey

Below is a collection of statements about your current state of mind. Please rate each of the
following statements using the scale provided about how you feel RIGHT NOW.
0 - Not at all
2 - Slightly
4 – Moderately
6 - Very much so

1. I want to limit the amount of food I eat to influence my shape or weight
2. I want to avoid eating for a long time (8 hrs or more) to influence my shape or weight
3. I want to exclude certain foods that I like from my diet to influence my shape or weight
4. I want to follow specific rules regarding my eating in order to influence my shape or weight
5. I want to have an empty stomach
6. I want to have a totally flat stomach
7. I am having difficulty concentrating right now because I am thinking about food, eating, or calories
8. I am having difficulty concentrating right now because I am thinking about my shape or weight
9. I feel like I am losing control over my eating
10. I am afraid of gaining weight
11. I feel fat
12. I have a strong desire to lose weight
13. I want to binge eat
14. I want to overeat on specific foods (i.e., pizza, cupcakes, etc.)
15. I want to make myself sick (vomit) to control my shape or weight
16. I want to take laxatives or diuretics to control my shape or weight
17. I want to take diet pills to control my shape or weight
18. I want to exercise intensively or for an extensive period of time in order to control my shape or weight
19. I want to eat in secret
20. I want to eat even though I am not hungry
21. I feel guilty about the food I ate recently
22. I am worried about other people judging me if they saw what I ate recently
23. I want to weigh myself
24. I am thinking I don’t want to know my weight
25. I want to body check (for example, feel my wrist or check my stomach, or look In the mirror)
26. I am feeling dissatisfied with my weight
27. I am feeling dissatisfied with my body shape

28. I am feeling dissatisfied with how my body looks
29. I feel uncomfortable with how my clothes fit my body right now
30. I am counting/I want to count calories in what I recently ate

Difficulties in Emotion Regulation – State

Please read each statement and indicate how much it applies to YOUR EMOTIONS RIGHT NOW.
1- Not at all
2- Somewhat
3- Moderately
4- Very much
5- Completely

1. I feel guilty for feeling this way.
2. I am paying attention to how I feel.
3. I feel out of control.
4. I am embarrassed for feeling this way.
5. I am feeling very bad about myself.
6. I am acknowledging my emotions.
7. I have no idea how I am feeling.
8. I feel ashamed with myself for feeling this way.
9. I am having difficulty doing the thing I need to do right now.
10. I believe that that I will continue feeling this way for a long time.
11. I care about what I am feeling.
12. I am angry with myself for feeling this way.
13. I am having difficulty controlling my behaviors.
14. I am confused about how I feel.
15. I believe that I am going to end up feeling very depressed.
16. I am taking time to figure out what I am really feeling.
17. My emotions feel out of control.
18. I am irritated with myself for feeling this way.
19. I believe that my feelings are valid and important.
20. I feel like I'm a weak person for feeling this way.
21. My emotions feel overwhelming.

Repetitive Thinking Questionnaire - State

Think of the last time you felt distressed or upset. Please report on what you are feeling RIGHT NOW about the situation.
Please use the following scale: 1-5
1-Not at all true
3-Somewhat true
5-Very true

1. I am thinking about all of my shortcoming, failing, faults, mistakes
2. Thoughts or images about the situation are coming into my head even though I don't want to think about them again.
3. I am thinking, "I won't be able to do my job/work because I feel so badly."
4. I can't forget thoughts or images about that situation.
5. I can't stop thinking about the situation.
6. I repeatedly notice that I am thinking about the situation.
7. I keep thinking about the situation even though I am trying not to.
8. I am continually thinking about the situation.
9. I keep thinking about the situation even though I know I shouldn't.
10. I keep thinking about the situation and wishing it would have gone better.

Eating Awareness Scale - State

Physical hunger is a physiological sensation that feels like a gnawing, emptiness, or growling in the stomach. It can be accompanied by your mouth salivating, fatigue, feeling jittery, lightheaded, or irritable ("hangry"). Physical hunger is your body's signal that you are low on energy and that your level of blood sugar is too low.

1. Please mark how physically hungry you are right now on the scale of 1-10, with 1 being not hungry at all and 10 being the most hungry.

Please indicate how well you think you can identify the following sensations using the scale provided (0 - Not at all, 2 – Slightly, 4 – Moderately, 6 - Very much so)

2. I can accurately identify how physically hungry I am right now
3. I can identify physiological sensations of hunger in my body

Psychological hunger is a desire to eat either out of habit, because you see or smell good food around you, because you are emotional or upset, or because it tastes good and is "fun." Psychological hunger is similar to craving. You may experience your mouth salivating, but other sensations of hunger are usually absent.

4. Please mark how psychologically hungry (how much you are craving food) you are right now on the scale of 1-10, with 1 being not psychologically hungry at all and 10 being the most psychologically hungry.

Please indicate how well you think you can identify the following sensations using the scale provided (0 - Not at all, 2 – Slightly, 4 – Moderately, 6 - Very much so)

5. I can accurately identify how psychologically hungry I am right now
6. I can tell the difference between physical and psychological hunger

Fullness is a physiological sensation in your stomach that indicates the degree to which the space in your stomach is filled with food or liquid. When your stomach is very full, it may feel heavy, distended, or bloated. You may feel pressure, stretching, or tightness around your stomach.

7. Please mark how full your stomach is right now on a scale of 1-10, 1 being not full at all and 10 being the most full.

Please indicate how well you think you can identify the following sensations using the scale provided (0 - Not at all, 2 – Slightly, 4 – Moderately, 6 - Very much so)

8. I can accurately identify how full my stomach is right now
9. I can tell whether I am feeling the sensations of fullness in my stomach right now

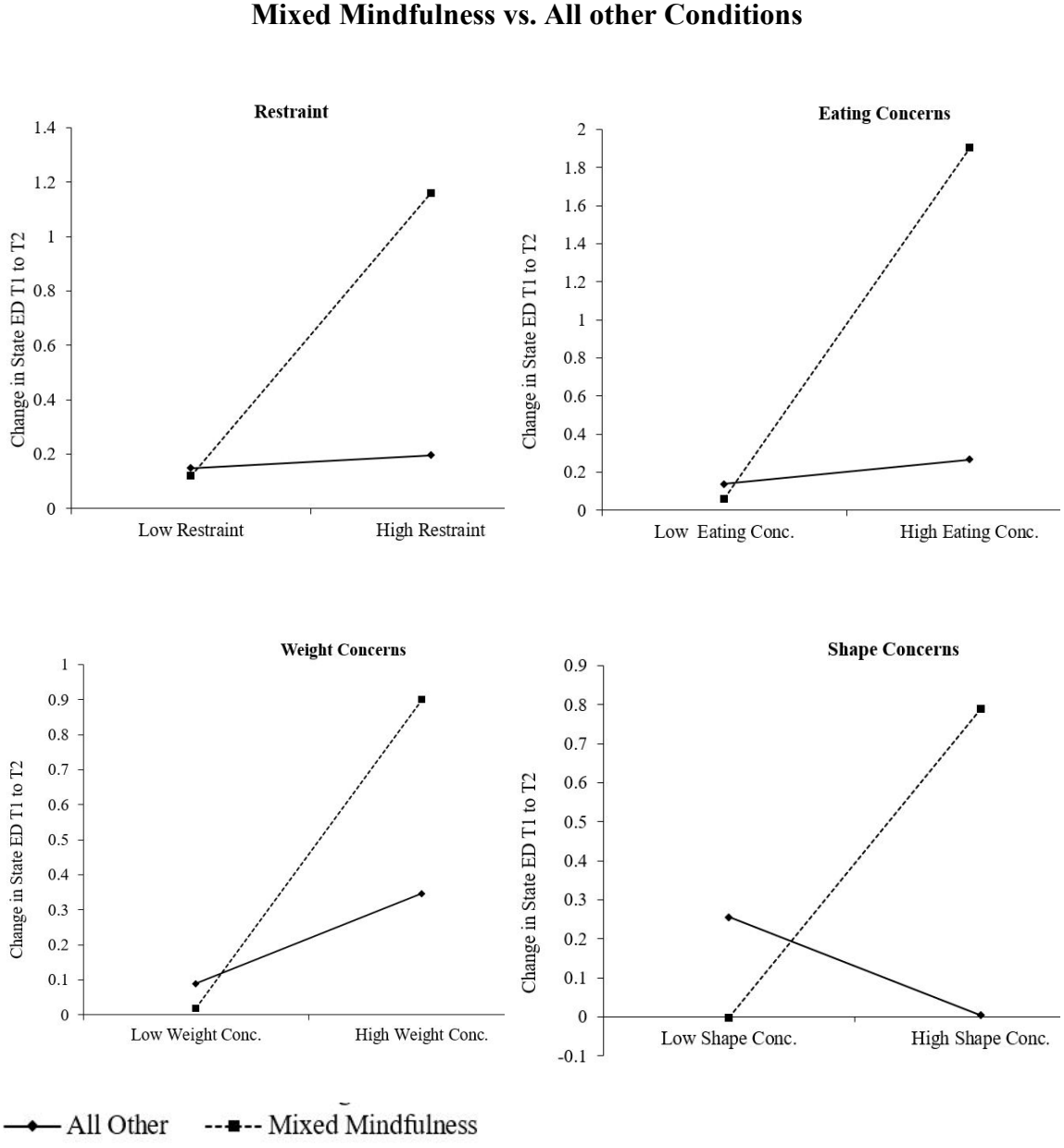
Satiety refers to both physical and psychological state of feeling content and satisfied with the meal. We feel satiated when the blood sugar raises again, and we may feel warm and relaxed. Satiety means that cravings are also satisfied, and we feel complete.

10. Please mark how satiated you are right now on the scale of 1-10, with 1 being not satiated at all and 10 being the most satiated.

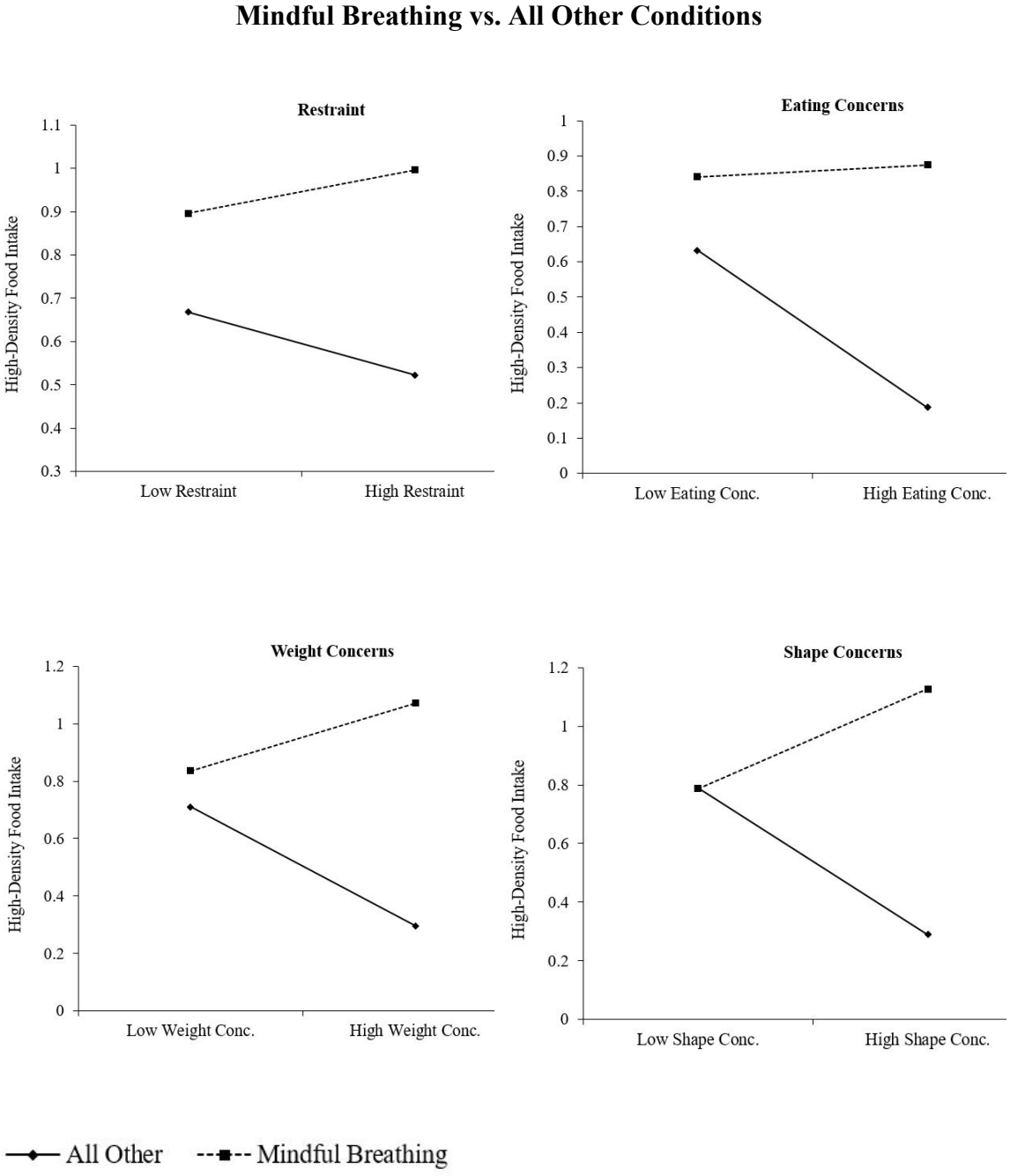
Please indicate how well you think you can identify the following sensations using the scale provided (0 - Not at all, 2 – Slightly, 4 – Moderately, 6 - Very much so)

11. I am able to identify how satiated I feel right now

Appendix 3. Interaction between the effects of baseline ED symptoms (by each EDEQ subscale) and study conditions on change in state ED symptoms.



Appendix 4. Interaction between the effects of baseline ED symptoms (by each EDEQ subscale) and study conditions on high-density food intake.



CURRIULUM VITAE

Irina A Vanzhula
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EDUCATION

August 2021 (Anticipated)	**Doctor of Philosophy in Clinical Psychology** University of Louisville, Louisville, KY Dissertation: *Manipulating mindful breathing versus mindful eating: examining the effect of specific mindfulness mechanisms on food intake and eating disorder symptoms.* Defended August 11, 2020 Faculty Advisor: Cheri Levinson, Ph.D.
July 2020 - Present	**Clinical Psychology Intern,** Track: Adult/Health University of Chicago Medicine, Chicago, IL Faculty Advisor: Jennifer Wildes, Ph.D.
December 2017	**Master of Science in Clinical Psychology** University of Louisville, Louisville, KY Faculty Advisor: Cheri Levinson, Ph.D.
May 2015	**Bachelor of Arts in Psychology** (summa cum laude) University of Illinois at Springfield, Springfield, IL
June 2007	**Master of Arts in Journalism** Saint-Petersburg State University, Saint-Petersburg, Russia
June 2007	**Bachelor of Arts in Journalism** Saint-Petersburg State University, Saint-Petersburg, Russia
August-December 2005	**International Exchange Student** University of Northern Iowa, Cedar Falls, IA

AWARDS & SCHOLARSHIPS

March 2020	**P.E.O. (Philanthropic Educational Organization) Scholar Award ($15,000)** A merit-based awards for women who are pursuing a doctoral-level degree chosen for their high level of academic achievement and their potential for having a positive impact on society
May 2020	**Award for Excellence in Research: Senior-Level** *Department of Psychological and Brain Sciences, University of Louisville*

Evidence of excellence in research, based on outstanding productivity, outstanding scholarship, or conceptually, technically, advanced, or creative work

April 2018 **The Graduate Student Council Research Grant ($500)**
College of Arts & Sciences, University of Louisville
Competitive grant to fund a dissertation study examining effects of mindfulness on disordered eating

May 2016 **Intramural Research and Creative Activities Grant ($500)**
College of Arts & Sciences, University of Louisville
Competitive grant to fund an independent research project testing the efficacy of Eating Awareness Training workshop in reducing disordered eating behaviors

August 2016-May 2019 **Graduate Network in Arts & Sciences Travel Award ($100-$250)**
College of Arts & Sciences, University of Louisville

February 2015 **The University Fellowship ($68,000)**
School of Interdisciplinary and Graduate Studies, University of Louisville
Merit-based competitive award (tuition and stipend) to conduct research while attending University of Louisville's doctoral program in clinical psychology

May 2015 **Outstanding Independent Student Research Award**
College of Liberal Arts and Sciences, University of Illinois at Springfield
Competitive award for the best undergraduate research project

October 2014 **Student-Faculty Creative Activities Award for Undergraduate Research ($3,000)**
College of Liberal Arts and Sciences, University of Illinois at Springfield
Competitive research grant to fund an independent study exploring stigma of eating disorders

March 2005 **International Student Exchange Grant ($12,000)**
Office of International Programs, University of Northern Iowa
Merit-based competitive award to fund one semester of study abroad (tuition, room, and board)

June 2002 **State Undergraduate Scholarship ($25,000)**
Saint-Petersburg State University, Saint-Petersburg, Russia
Merit-based competitive award to cover tuition cost for 5 years pursuing undergraduate and graduate degrees

PEER-REVIEWED PUBLICATIONS (*N* = 21)

Roos, C.R., Sala, M., Kober, H., **Vanzhula, I.A.**, Levinson, C.A. (In press). Mindfulness-based interventions for eating disorders: The potential to mobilize multiple associative-learning change mechanisms. International Journal of Eating Disorders.

Vanzhula, I. A., Kinkel-Ram, S., & Levinson, C. A. (2021, Advanced online publication). Perfectionism and Difficulty Controlling Thoughts Bridge Eating Disorder and Obsessive-Compulsive Disorder: A Network Analysis. *Journal of Affective Disorders*.

Levinson, C.A., **Vanzhula, I.A.,** Woods, T., & Stice, E. (2020, Advanced online publication). Longitudinal and personalized networks of eating disorder symptoms in adolescents at risk for an eating disorder. *International Journal of Eating Disorders.*

Vanzhula, I.A., Sala, M., Christian, C., Hunt, R.A., Keshishian, A., Wong, V.Z., Ernst, S., Spoor, S., & Levinson, C. A. (2020). Avoidance coping during mealtimes predicts an increase in eating disorder symptoms. *International Journal of Eating Disorders, 53*(4):625-630.

Vanzhula, I.A. & Levinson, C.A. (2020). Mindfulness in the Treatment of Eating Disorders: Theoretical Rationale and Hypothesized Mechanisms of Action. *Mindfulness, 11:*1090–1104.

Levinson, C.A., Christian, C., Shankar Ram, S., **Vanzhula, I.A.**, Brosof, L.C., Michelson, L., & Williams, B. (2020). Eating disorder symptoms and core eating disorder fears decrease during online imaginal exposure therapy for eating disorders. *Journal of Affective Disorders, 276*(1), 585-591.

Sala, M., Shankar Ram, S., **Vanzhula, I.A.**, & Levinson, C. A. (2020). Mindfulness and eating disorder psychopathology: A meta-analysis. *International Journal of Eating Disorders, 53*(6), 834-851.

Brown, T. A., **Vanzhula, I**. Reilly, E. E., Levinson, C. A., Berner, L. A., Krueger, A., Lavender, J. M., Kaye, W. H., & Wierenga, C. W. (2020). Body Mistrust is a Bridge Pathway between Interoceptive Awareness and Eating Disorder Symptoms. *Journal of Abnormal Psychology, 129*(5), 445–456.

Christian, C, Williams, B.M., Hunt, R.A., Wong, V.Z., Ernst, S.E., Spoor, S.P., **Vanzhula, I.A.**, Tregarthen, J.P., Forbush, K.T., & Levinson, C.A. (2019, Advanced online publication). A Network investigation of core symptoms and pathways across duration of illness using a comprehensive cognitive-behavioral model of eating disorder symptoms. *Psychological Medicine.*

Levinson, C. A., **Vanzhula, I. A**., & Christian, C. (2019). Development and validation of the Eating Disorder Fear Questionnaire and Interview: Preliminary investigation of eating disorder core fears. *Eating Behaviors, 35,* 101320.

Brosof, L.C., Egbert, A.H., Wonderlich, J., Reilly, E.E, Karam, A., Steward, T., **Vanzhula, I.A.**, & Cheri A. Levinson, Ph.D. (2019). Intolerance of uncertainty moderates the relationship between high personal standards but not evaluative concerns perfectionism and eating disorder symptoms cross-sectionally and prospectively over two weeks. *Eating Behaviors, 35:*101340.

Christian, C., Perko, V.L., **Vanzhula, I.A.**, Tregarthen, J.P., Forbush, K.T., & Levinson, C.A. (2020). Eating Disorder Core Symptoms and Symptom Pathways Across Developmental Stages. *Journal of Abnormal Psychology, 129*(2), 177–190.

Christian, C., Brosof, L.C., **Vanzhula, I.A.**, Williams, B.M., Shankar Ram, S., & Levinson, C.A. (2019). Implementation of a dissonance-based, eating disorder prevention program in Southern, all-female high schools. *Body Image, 30*, 26-34.

Levinson, C. A., Christian, C., & **Vanzhula, I. A**. (2019, Advanced online publication). Manipulating the theoretical framing of exposure therapy for eating disorders impacts clinicians' treatment preferences. *Eating and Weight Disorders.*

Farrell, N. R., Brosof, L. C., **Vanzhula, I. A**., Christian, C., Bowie, O. R., & Levinson, C. A. (2019). Exploring mechanisms of action in exposure-based cognitive behavioral

therapy for eating disorders: The role of eating-related fears and body-related safety behaviors. *Behavior Therapy*, *50*(6), 1125-1135.

Vanzhula, I.A., Calebs, B., Fewell, L., & Levinson, C.A. (2018). Irritability and concentration difficulties are illness pathways between eating disorder and post-traumatic stress disorder symptoms: Understanding comorbidity with network analysis. *European Eating Disorder Review, 27*(2), 147-160.

Sala, M., **Vanzhula, I. A**., & Levinson, C. A. (2018). A longitudinal study on the association between facets of mindfulness and eating disorder symptoms in individuals with eating disorders. *European Eating Disorder Review, 27*(3), 295-305.

Levinson, C.A., **Vanzhula, I.A.**, Brosof, L.C., & Forbush, K. (2018). Network analysis as an alternative approach to conceptualizing eating disorders: Implications for research and treatment. *Current Psychiatry Reports, 20*(9), 67.

Levinson, C. A., Brosof, L.C., **Vanzhula, I.A**., Christian, C., Jones, P., Rodebaugh, T.L., Langer, J.K., White, E.K., Warren, C., Weeks, J.W., Menatti, A., Lim, M.H., & Fernandez, K.C. (2018). Social anxiety and eating disorder comorbidity and underlying vulnerabilities: Using network analysis to conceptualize comorbidity. *International Journal of Eating Disorder, 51*(7), 693-709.

Levinson, C.A., **Vanzhula, I.A.**, & Brosof, C.L. (2018). Longitudinal and personalized networks of eating disorder cognitions and behaviors: Targets for precision intervention. *International Journal of Eating Disorders*, 51(11),1233-1243.

Levinson, C.A., Brosof, L.C., **Vanzhula, I.A.,** Bumberry, L., Zerwas, S., & Bulik, C. M. (2017). Perfectionism group treatment for eating disorders in an inpatient, partial hospitalization, and outpatient setting: Preliminary support for reducing high standards but not concern over mistakes. *European Eating Disorder Review*, 25(6), 579-585.

MANUSCRIPTS UNDER REVIEW

Vanzhula, I.A., Christian, C., Jones, P., Brosof, L.C., Forbush, K., Smith, K., Tregarthen, J., Farrell, N.A., & Levinson, C.A. (Under Review). *Replicability of eating disorder psychological networks in five samples: Conceptual and methodological considerations.*

Peiper, N.C., Brosof, C.L., **Vanzhula, I.A.**, & Levinson, C.A. (Under Review). *The prevalence of eating disorder behaviors and associated risky behaviors in an epidemiological survey of high school students in Kentucky*.

Brosof, L. C., Michelson, L. P., Christian, C., **Vanzhula I.A.**, Williams, B. M., Shankar Ram, S., Levinson, C. A. (Under Review). *Age moderates the relationship between anxiety about eating and eating disorder symptoms.*

Spoor, S.P, Michelson, L.P., **Vanzhula, I.A.** & Levinson, C.A. (Under Review). Preliminary Development and Psychometric Properties of the Gender Performativity Measure: Toward a Quantitative Understanding of Gender Performance.

MANUSCRIPTS IN PREPARATION

Vanzhula, I.A., Perko, V., Forbush, K., Tregarthen, J., & Levinson, C.A. (In Prep). *Core symptoms of eating disorders: Variability across eating disorder diagnoses and assessment instruments.*

Vanzhula, I.A., Sala, M., Newton, K.S., Levinson, C.A. (In Prep). *Eating awareness group training reduces subclinical eating disorder symptoms.*

Vanzhula, I.A., Spoor, S.P., Ernst, S.E., Farrell, N.R., Essayli, J.H., & Levinson, C.A. (In Preparation). *Testing the psychometric properties of the Fear of Food Measure in clinical and non-clinical adolescent samples*.

Peat, C.M., **Vanzhula, I.A.**, Levinson, C.A., & Mitchell, H. (In Prep). *Predicting weight loss, disordered eating, and quality of life outcomes in LABS-2 using a network analysis approach.*

Sala, M., **Vanzhula I.A.**, Roos, C., & Levinson C.A. (In Prep). *Mindfulness and Eating Disorders: A Network Analysis.*

Ernst, S. E., **Vanzhula, I. A.**, Levinson, C.A. (In Prep). *Personal Standards, but not Maladaptive Evaluative Concerns Perfectionism Predicts Exercise Dependency Over Time*.

Roos, C.R., Sala, M., Kober, H., **Vanzhula, I.A.**, & Levinson, C.A. (In Prep). *Mindfulness-based intervention for anorexia and bulimia nervosa: The potential to modify associative learning processes*.

Levinson, C.A., Hunt, R.A., Keshishian, A.C., Brown, M.L., **Vanzhula, I.A**., Christian, C., Brosof, L.C., & Williams, B.M. (In Prep). *Using Individual Networks to Identify Treatment Targets for Eating Disorder Treatment: A Proof of Concept Study and Initial Data.*

Levinson, C.A., Hunt, R.A., Christian, C., Williams, B.M., Keshishian, A.C., **Vanzhula, I.A.,** Ralph-Nearman, C., & Henry, T. (In Prep). *Longitudinal Group and Individual Networks of Eating Disorder Symptoms in Individuals Diagnosed with an Eating Disorder.*

WORKSHOPS AND INVITED TALKS

Levinson, C.A. & **Vanzhula, I.A.** (March 2020). Conducting Network Analysis in R. Webinar presented for the Academy of Eating Disorders Early Career Special Interest Group.

Vanzhula, I.A. (Sept. 2019). *Does your client have an eating disorder? Foundations of eating disorder assessment and treatment.* Workshop presented at the Continuing Education Conference Mental Health Practice in Rural/Underserved Setting at the Murray State University, Murray, KY.

Waters, C. & **Vanzhula, I.A.** (May 2019). *Body image and eating disorders.* Talk presented to the students of Eminence High School, Eminence, KY.

Vanzhula, I.A. & Brosof, L.C. (Mar. 2019). *An introduction to network analysis for psychology: Theory to practice.* Workshop presented to the faculty and graduate students at the Department of Psychological and Brain Sciences at the University of Louisville.

Pruitt, A., Waters, C., & **Vanzhula., I.A.** (Nov. 2018). *Evidence-based treatments for eating disorders: Assessment, treatment, and when to refer.* Workshop presented at the Western Kentucky Mental Health Counselling Association Fall Conference in Paducah, KY.

Sala, M., **Vanzhula, I.A**., Juarascio, A., Vazzano, K., & Levinson, C.A. (Apr. 2018). *Incorporating mindfulness into eating disorder research and treatment.* Workshop presented at the International Conference on Eating Disorders, Chicago IL.

Vanzhula, I.A. (March 2017). *Basics of Mindful Eating.* Workshop presented to the Kentucky Air National Guard, Louisville, KY.

PAPER/SYMPOSIUM PRESENTATIONS

Vanzhula, I.A., Henry, T., Cusack, C., Williams, B., Keshishian, A., & Levinson, C.A. (Nov. 2021). *Controllability Centrality as a New Tool for Selecting Targets for Eating Disorder Intervention.* Paper to be presented at the annual meeting of the Association for Behavioral and Cognitive Therapies in New Orleans, LA. In Jordan, D. Novel Analytic Approaches to Clinical Science: Integrating Recent Advances to Statistical Methodology.

Vanzhula, I.A., Williams, K., & Levinson, C.A. (Nov. 2020). *Higher fluctuation in anxiety before, during, and after meals is associated with less food restraint.* Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Virtual Meeting. In **I.A. Vanzhula** & E.E. Reilly: "Can't fight this feeling…" Emerging Constructs and New Perspectives on Affective Theories of Eating Disorders.

Vanzhula, I.A., Christian, C., Ernst, S., Drake, J., & Levinson, C.A. (Nov. 2020). *Item Selection Approaches in Network Analysis: An Eating Disorder Network Example.* Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Virtual Meeting. In D. Jordan: Novel Analytic Methods for Clinical Science: Recent Approaches to Modeling Psychopathology.

*Spoor, S.P., **Vanzhula, I.A.**, Brosof, L.C., Michelson, L.P., & Levinson, C.A. (Nov. 2020). *Internalized weight bias moderates the relationships between anxiety about gender expression and eating disorder pathology.* Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Virtual Meeting. In C. Warren: Eating Pathology in Sexual and Gender Minority Populations: Sociocultural Risk Factors, Assessment Considerations, and Treatment Outcomes.

Levinson, C.A., **Vanzhula, I.A.**, Brosof, L.C., & Christian, C. (Nov. 2020). *An In-person Prolonged Imaginal Exposure Therapy Protocol for Eating Disorders Is Associated with Decreased Eating Disorder Symptoms, Anxiety, and Eating Disorder Fears*. Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Virtual Meeting. In R. Butler: New Directions in Exposure Therapy For Eating Disorders.

Levinson, C.A., Hunt, R.A., Christian, C., Williams, B., Keshishian, A., **Vanzhula, I.A.** (Nov. 2020). *Personalized Models of Eating Disorder Symptoms Across 25 Days: Implications for Precision Intervention*. Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Virtual Meeting. In J. Reeves & H. Bosley: Advances in Idiographic Clinical Science: Highlighting the Clinical Utility of the Person-specific Approach.

Farrell, N. R., Brosof, L. C., **Vanzhula, I. A**., Christian, C., Bowie, O. R., & Levinson, C. A. (Nov. 2020). *Early Changes in Eating-related Fears and Body-related Safety Behaviors Predict Treatment Outcome in Exposure-based CBT for Eating Disorders.* Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Virtual Meeting. In D. Walker: Pizza, Mirrors, and Fullness, Oh My!

Understanding Mechanisms of Change Underlying Exposure Interventions For Eating Disorders.

Levinson, C.A., Christian, C., & **Vanzhula, I.A.** (Nov. 2019). *Eating disorder clinicians' perceptions of exposure therapy for eating disorders.* Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Atlanta, GA. In Essayli, J.: The feasibility of exposure therapy for eating disorders.

Levinson, C.A., Christian, C., Shankar Ram, S., **Vanzhula, I.A.**, Brosof, L.C., Michelson, L., Williams, B. (Sept. 2019). *Online imaginal exposure therapy for eating disorders decreases eating disorder symptoms and core eating disorder fears.* Paper presented at the annual meeting of the Eating Disorder Research Society in Chicago, IL.

Brown, T.A., **Vanzhula, I.A.**, Reilly, R.E., Levinson, C.A., Lavender, J.M., Berner, L.A., Krueger, A., Wierenga, C.E., Kaye, W.H. (Mar. 2019). *Network analysis of interoceptive awareness and eating disorder symptoms.* Paper presented at the Academy of Eating Disorders, International Conference on Eating Disorders, New York, NY.

O'Connor, S.S., Brosof, L.C., **Vanzhula, I.A.,** & Levinson, C.A. (Apr. 2019). *Eating disorder fears are uniquely associated with suicidality.* Paper presented at the American Association of Suicidology conference, Denver, CO.

Vanzhula, I.A., Smith, T.W., Levinson, C.A., Stice, E. (Mar. 2019). *Personalized networks of eating disorder symptoms in high school students: Targets for individualized treatments.* Paper presented at the Academy of Eating Disorders, International Conference on Eating Disorders, New York, NY.

Sala, M., Shankar Ram, S., **Vanzhula, I.A.**, & Levinson, C.A. (Mar. 2019). *Mindfulness and eating disorder psychopathology: A meta-analysis.* Paper presented at the Academy of Eating Disorders, International Conference on Eating Disorders, New York, NY.

Vanzhula I.A., Christian, C., Brosof, L. C., Shankar Ram, S., Michelson, L., Levinson, C. A. (Nov. 2018). *Rumination and lack of mindful awareness prospectively predict eating disorder symptoms.* Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Washington, DC. In L.C. Brosof: Transdiagnostic processes in eating disorders: How shared mechanisms can inform treatment.

Brosof, L. C., **Vanzhula, I.A.**, Shankar Ram, S. Christian, C., Michelson, L., & Levinson, C.A. (Nov. 2018). *Interacting risk factors: Higher emotional impulsivity and lower maladaptive perfectionism is associated with higher bulimic symptoms*. Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Washington, DC. In L.C. Brosof: Transdiagnostic processes in eating disorders: How shared mechanisms can inform treatment.

Levinson, C.A., **Vanzhula, I.A.**, & Michelson, L. (Nov. 2018). *Personalized networks of symptoms at mealtime in individuals with eating disorders: Identifying individual mealtime intervention targets.* In A. Fisher & P. Soyster: Seeing Trees for the Forest: Personalized and Precision Approaches to Discrete Behavior Change. Paper presented at the Association for Behavioral and Cognitive Therapies, Washington D.C.

Brosof, L. C., **Vanzhula, I. A.,** & Levinson, C. A. (Nov. 2018). *A combined latent variable and network model of eating disorder symptoms in two eating disorder measures.* In S. Wang: Novel insights on eating disorder treatment and etiology from network and complexity science. Paper presented at the Association for Behavioral and Cognitive Therapies, Washington D.C.

Vanzhula, I.A., Margaret, S., Levinson, C.A. (Apr. 2018). *Improving acting with awareness may be the key to successful mindfulness-based interventions for eating disorders*. Paper presented at the International Conference on Eating Disorders, Chicago IL.

Levinson, C.A., **Vanzhula, I.A.**, Michelson, L., Fewell, L. (Apr. 2018). *Personalized networks of symptoms vary across individuals with eating disorders supporting need for individualized treatments.* Paper presented at the International Conference on Eating Disorders, Chicago IL.

Levinson, C.A., **Vanzhula, I.A.,** & Christian C., (Apr. 2018). *Development and validation of the eating disorder fear questionnaire and interview.* Paper presented at the International Conference on Eating Disorders, Chicago IL.

Levinson, C.A., **Vanzhula, I.A**., Calebs, B. (Nov. 2017). *The relationship between eating disorder cognitions and behaviors: Using intraindividual network analysis to identify personalized intervention targets*. In Sarah David (chair). Intraindividual Network Analysis - Implications for Clinical Assessment and Individualized Treatment Planning. Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, San Diego, CA.

Levinson, C.A., **Vanzhula, I.A.**, Brosof, L.C., Michelson, L.M., Calebs, B., Fewell, L.K. (Nov. 2017). *A trial of online imaginal exposure therapy for eating disorder related fears in individuals with anorexia nervosa.* In Farrell, N (chair). A New Way Forward? Novel Applications of Exposure-Based Therapy in the Context of Eating Disorders. Paper presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, San Diego, CA.

POSTER PRESENTATIONS

*Spoor, S.P., **Vanzhula, I.A.**, Ernst, S.E., Farrell, N.R., Essayli, J.H., & Levinson, C.A. (2021, November). *Evaluating the psychometric properties of the fear of food measure among adolescents in treatment for an eating disorder.* Poster to be presented at the Association for Behavioral and Cognitive Therapies, New Orleans, Louisiana.

Vanzhula, I.A. & Levinson, C.A. (Oct. 2020). *Individuals high in eating disorder symptoms benefit the most from a combination of mindful breathing and mindful eating practices.* Poster to be presented at the annual virtual meeting of the Eating Disorder Research Society.

*Spoor, S.P., **Vanzhula, I.A.**, Michelson, L.P., & Levinson, C.A. (Nov. 2020). *The eating pathology symptom correlates of gender performativity in a cisgender sample.* Poster to be presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Philadelphia, Pennsylvania.

*Ernst, S. E., **Vanzhula, I.A**, Levinson, C. A., (Nov. 2020). *Perfectionism Predicts Exercise Dependency over Time in Adolescent Females.* Poster to be presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Philadelphia, PA.

Shankar Ram, S., **Vanzhula, I. A.**, & Levinson, C. A. (Nov. 2019). *Bridge symptoms between obsessive- compulsive disorder and eating disorders in individuals with eating*

disorders. Poster to be presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Atlanta, GA.

Spoor, S.P., Ernst, S.E., **Vanzhula, I.A.**, & Levinson, C.A. (Nov. 2019). *Testing the psychometric properties of the fear of food measure in a female adolescent sample.* Poster to be presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Atlanta, GA.

Vanzhula, I.A., McCloud, M., & Levinson, C.A. (Nov. 2019). *Trait mindfulness increases during exposure therapy for eating disorders.* Poster to be presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Atlanta, GA.

Williams, B. M., **Vanzhula, I.A.,** Chapman, L., & Levinson, C. A. (Nov. 2019). *Emotional avoidance and guilt are core symptoms during mealtimes among individuals with eating disorders.* Poster to be presented at the annual meeting of the Association of Behavioral and Cognitive Therapies, Atlanta, GA.

Vanzhula, I.A., Christian, C., Jones, P., Brosof, L.C., Forbush, K., Smith, K., Tregarthen, J., Farrell, N.A., & Levinson, C.A. (Sept. 2019). *Replicability of eating disorder psychological networks in five samples: Conceptual and methodological considerations.* Poster presented at the annual meeting of the Eating Disorder Research Society in Chicago, IL.

Shankar Ram, S., **Vanzhula, I. A.**, & Levinson, C. A. (Nov. 2019). *Bridge symptoms between obsessive-compulsive disorder and eating disorders in individuals with eating disorders.* Poster to be presented at annual meeting of the Association for Behavioral and Cognitive Therapies, Washington, DC.

*Ernst, S., **Vanzhula, I.A**., & Levinson, C.A. (July 2019). *Personal standards but not maladaptive evaluative concerns perfectionism predict exercise dependency over time.* Poster presented at University of Louisville Undergraduate Research Symposium at the University of Louisville, Louisville, KY.

Vanzhula I.A., Perko, V., Forbush, K., Tregarthen, J., Levinson, C.A. (Mar. 2019). *Core symptoms of eating disorders: Variability across eating disorder diagnoses and assessment instruments*. Poster presented at the International Conference on Eating Disorders, New York, NY.

Vanzhula, I.A., Witten, J., & Levinson, C.A. (Mar. 2019). *Shame moderates the relationship between eating disorder cognitions and depression.* Poster presented at the International Conference on Eating Disorders, New York, NY.

Vanzhula I.A., Christian, C., Perko, V., Levinson, C.A., Forbush, K., Tregarthen, J. (Nov. 2018). *Core symptoms of eating disorders: Using network analysis to examine variability across eating disorder diagnoses.* Poster presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Washington, DC.

Vanzhula I.A., Sala, M., Christian, C., Levinson, C.A. (Nov. 2018). *Avoidance predicts lower anxiety in the short-term but increased eating disorder symptoms over time.* Poster presented at the annual meeting of the Association for Behavioral and Cognitive Therapies, Washington, DC.

*Coale, K., **Vanzhula, I.A.,** Christian, C., & Levinson, C. A. (Nov. 2018). *Shame, fear of food, and fear of weight gain uniquely relate to eating disorder psychopathology.* Poster presented at the Association for Behavioral and Cognitive Therapies convention in Washington, DC.

Vanzhula, I. A., Coale, K., & Levinson, C. A. (Apr. 2018). *Shame and guilt may be the key to understanding and treating comorbid depression and eating disorders.* Poster presented at the Anxiety and Depression Association of America conference in Washington, DC.

Vanzhula, I. A. & Levinson, C. A. (Nov. 2017). *Shared vulnerabilities for social anxiety, binge eating, and obesity.* Poster presented at the Association for Behavioral and Cognitive Therapies convention in San Diego, CA.

Vanzhula, I.A., Christian, C., Calebs, B., Levinson, C.A. (Apr. 2018). *Irritability and concentration difficulties link eating disorder and PTSD symptoms: Understanding comorbidity with network analysis.* Poster to be presented at the International Conference of Eating Disorders, Chicago, IL.

Levinson, C.A., Brosof, L.C., **Vanzhula, I.A**., Bumberry, L., Zerwas, S., Bulik, C.M. (Apr. 2018). *Perfectionism group treatment for eating disorders in an inpatient, partial hospitalization, and outpatient setting: Preliminary support for reducing high standards but not concern over mistakes.* Poster to be presented at the International Conference on Eating Disorders, Chicago IL.

*Christian C., **Vanzhula I.A.**, Levinson, C.A. (Apr. 2018). *Shared and unique vulnerabilities for alcohol abuse and binge eating.* Poster presented at University of Louisville Undergraduate Research Symposium at the University of Louisville, Louisville, KY.

*Treager, A.L., **Vanzhula I.A.,** Levinson, C.A. (Apr. 2018). *Unique associations between mindfulness facets and body dissatisfaction within eating disorder symptomatology.* Poster presented at University of Louisville Undergraduate Research Symposium at the University of Louisville, Louisville, KY.

*Gates, C., **Vanzhula I.A.**, Levinson, C.A. (Apr. 2018). *The moderating role of intolerance of uncertainty in the relationship between eating disorders and fear of food.* Poster presented at University of Louisville Undergraduate Research Symposium at the University of Louisville, Louisville, KY.

** Indicates mentorship of undergraduate student project*

RESEARCH EXPERIENCE

Graduate Research Assistant ♦ Eating Anxiety Treatment laboratory (August 2016 – June 2020)
University of Louisville, Louisville, KY
Supervisor: Cheri Levinson, Ph.D.

Dissertation Project
Manipulating mindful breathing versus mindful eating: examining the effect of specific mindfulness mechanisms on food intake and eating disorder symptoms
An experimental study examines whether mindful eating, mindful breathing, or a combination of the two are effective at reducing eating disorder symptoms. The study also tests if rumination, emotion regulation, and awareness of hunger and satiety mediate this effect.

- Developed study idea and designed study protocol
- Trained research assistants on study protocol and supervised data collection

- Applied for and received the Graduate Student Council Research Grant ($500) for study supplies

Independent Project, P.I.
Eating Awareness Training for individuals with subclinical disordered eating
Pilot study testing the feasibility and preliminary outcomes of a four-session group mindfulness-based intervention designed to increase participants' awareness of hunger and fullness cues and their ability to differentiate between physiological and psychological hunger. The workshop includes psychoeducation, mindfulness meditation, and mindful eating practices

- Developed study idea and study protocol and designed four treatment modules
- Led six workshops and supervised data collection
- Applied for and received Intramural Research and Creative Activities Grant ($500) for study supplies

Independent Project, Co-P.I.
Self-compassion group for individuals with eating disorders: A pilot study
Pilot study testing feasibility and preliminary outcomes of self-compassion group for individuals with anorexia and bulimia nervosa

- Participated in development of the study idea and study protocol

Independent Project, Co-P.I.
Mental rituals in eating disorders (2019 – Present)
Development and validation of a questionnaire to assess mental rituals in individuals with eating disorders

- Conducted literature searches and participated in the initial development of items

Other Lab Projects
Online imaginal exposure study (P.I.: Cheri Levinson, Ph.D.)
The study examines if the use of imaginal exposure therapy can be useful in reducing eating-related anxiety in individuals with past or current eating disorders

- Screened participants over the phone using the SCID and MINI and determined eligibility
- Trained research assistants to conduct screenings and enter and clean data
- Assisted in manuscript preparation

Daily habits ecological momentary assessment (P.I.: Cheri Levinson, Ph.D.)
The study examines cognitions and behaviors around mealtimes in individuals with past and current eating disorders. Participants answer questions about their daily habits using the phone application several times a day for three weeks

- Screened participants over the phone using the SCID and MINI and determine eligibility
- Enrolled participants in the study; Conducted data analyses
- Trained research assistants to conduct screenings, enter, and score data

Clinical outcomes study (P.I.: Cheri Levinson, Ph.D.)
The study assesses treatment outcomes at the affiliated eating disorder outpatient clinics. Participants complete online surveys during intake and monthly throughout treatment

- Created online surveys and administered monthly surveys to patients
- Trained research assistants to enter and clean data

Graduate Research Assistant ♦ Health Behavior Change Laboratory (August 2015 – May 2016)
University of Louisville, Louisville, KY
Supervisor: Barbara Stetson, Ph.D.
Hypoglycemia-related anxiety and physical activity study
The study examined general and diabetes-specific fear of hypoglycemia as a barrier to lifestyle and structured physical activity in adults with diabetes

- Data management and manuscript preparation

Undergraduate Research Assistant (August 2014 – May 2015)
University of Illinois at Springfield, Springfield, IL
Supervisor: Carrie Switzer, Ph.D.
Independent Study: Stigma of eating disorders study
The study examines the association between knowledge about eating disorders and stigmatizing attitudes towards eating disorders.

- Designed and executed an independent research project
- Applied for and received Student-Faculty Creative Activities Award for Undergraduate Research award ($3,000) for study expenses and conference travel

STATISTICAL TRAINING

- ♦ Structural Equation Modeling in Longitudinal Research (5-day intensive training, June 2020)

APA Advanced Training Institute, Online | *Instructors: Kevin Grimm, Ph.D., Nilam Ram, Ph.D*

- ♦ Introduction to Structural Equation Modeling (3-day workshop, May 2020)

Curran-Bauer Analytics, Online | *Instructors: Patrick Curran, Ph.D. & Daniel Bauer, Ph.D*.

- ♦ Analysis of Intensive Longitudinal Data: Experience Sampling and Ecological Momentary Assessment (5-day APA Advanced Training Institute, June 2019)

Arizona State University, Tempe, AZ | *Instructors: Niall Bolger, Ph.D., Kevin Grimm, Ph.D., Nilam Ram, Ph.D.*

- ♦ Advanced Multivariate Statistics Course (2018)

University of Louisville, Louisville, KY | *Instructor: Benjamin Mast, Ph.D.*

- ♦ Network Analysis Summer School (5-day intensive training, September 2017)

University of Amsterdam, Amsterdam, Netherlands | *Instructors: Sacha Epskamp, PhD, Eiko Fried, PhD, Adela Isvoranu, MS.*

CLINICAL RESEARCH EXPERIENCE

Clinical Trial Therapist ♦ Eating Anxiety Treatment Laboratory (January 2016 – May 2020)
Department of Psychological and Brain Sciences, University of Louisville, Louisville, KY
Supervisor: Cheri Levinson, Ph.D.

Pilot Clinical Trial: Personalized Treatment for Eating Disorders
The study examines feasibility and initial outcomes of creating and implementing a personalized treatment plan for individuals with eating disorders based on a data-derived individual symptom profile

- Assisted in the development of the study protocol and manual
- Screened participants using SCID and MINI to determine eligibility
- Administered structured eating disorder interview and provide psychoeducation on the individualized symptom profile
- Collected ecological momentary assessment data over two weeks and created an individualized symptom profile using network analysis
- Created a six-session treatment plan based on the identified core symptoms using empirically-based interventions
- Created therapist and participant manuals for each participant and administer the treatment protocol

Pilot Clinical Trial: In-Vivo Imaginal Exposure for Eating Disorders
The study investigates if the use of imaginal exposure therapy can be helpful in reducing eating-related anxiety. The ten-session treatment manual is based on the prolonged exposure for PTSD protocol and targets core eating disorder fears

- Screened participants using SCID and MINI and determined eligibility
- Helped participants identify their core eating disorder fears and created a fear script
- Conducted imaginal and in-vivo exposures related to the core fears

CLINICAL EXPERIENCE

Intern Therapist ♦ Department of Psychiatry and Behavioral Neuroscience, University of Chicago Medicine, Chicago, IL (July 2020 – Present)
Setting: Clinical service and training unit within the medical center, and an academic unit within the Division of Biological Sciences and the Pritzker School of Medicine. The Adult Psychiatry Section provides outpatient psychotherapy and medication management services and includes several specialty clinics

Outpatient Clinical Service
Supervisors: Nancy Beckman, Ph.D. & Maureen Lacy, Ph.D.

- Conduct individual psychotherapy with adults suffering from a variety of psychological conditions across the diagnostic spectrum via telehealth
- Collaborate with psychiatry and other health professionals to coordinate patient care
- Receive 2 hours of weekly individual supervision from licensed psychologists

Eating Disorders Program
Supervisor: Jennifer Wildes, Ph.D.

- Provide individual and family therapy to individuals suffering from anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED), other specified feeding or eating disorder (OSFED), and avoidant restrictive food intake disorder (ARFID) via telehealth
- Implement cognitive-behavioral therapy for eating disorders (CBT-E) and family-based treatment (FBT)
- Work on an interdisciplinary team of psychologists, psychiatrists, and physicians
- Participate in a weekly interdisciplinary supervision team meeting and didactics
- Receive weekly individual supervision from a licensed psychologist

The Center for the Surgical Treatment of Obesity
Supervisor: Jennifer Wildes, Ph.D.

- Conduct bariatric pre-surgical psychological assessments
- Write-up assessment reports outlining recommendations
- Communicate assessment results to the bariatric team

Practicum Student Therapist ♦ Louisville Center for Eating Disorders | Louisville OCD Clinic | Behavioral Wellness Clinic, Louisville, KY (June 2018 – April 2020).
Setting: A private treatment facility that houses three clinics. The Louisville Center for Eating Disorders staffs an interdisciplinary team of psychologists, dietitians, and psychiatrists to provide outpatient and intensive outpatient services to individuals with eating disorders. The Louisville OCD Clinic provides outpatient and intensive outpatient services for obsessive-compulsive disorder (OCD) and related disorders. The Behavioral Wellness Clinic offers outpatient services for a wide range of psychological conditions

Eating Disorder Intensive Outpatient Program
Supervisor: Alexandria Pruitt, Psy.D.

- Provided individual, group, and family therapy to individuals suffering from AN, BN, BED, OSFED, and ARFID
- Worked on an interdisciplinary team of psychologists, dietitians, psychiatrists, and physicians
- Conducted intake assessments and make recommendations for appropriate level of care
- Conducted weekly meal therapy and CBT groups
- Participated in a weekly interdisciplinary supervision team meeting and receive weekly individual supervision from a licensed psychologist
- Attended monthly didactic trainings in evidence-based treatments
- Educated new therapists and practicum students on intake procedures and levels of care

Louisville OCD Clinic / Behavioral Wellness Clinic
Supervisor: Street Russell, Psy.D.

- Conducted individual, family, and group therapy with adults and children with a variety of psychological conditions
- Administered diagnostic (Y-BOCS, CY-BOCS, MINI, and MINI-KID) and treatment outcome assessments
- Participated in weekly group and individual supervision led by a licensed psychologist
- Led outpatient eating-disorder-focused DBT skills group
- Provided individual therapy to adults and children daily during a two-week intensive outpatient OCD program

Practicum Student Therapist ♦ University of Louisville Outpatient Psychiatry Depression Center Louisville, KY (June 2017 – May 2018)
Setting: Academic medical center dedicated to research and treatment of depression and bipolar disorder. The center provides medication management and psychotherapy services to individuals with chronic and severe mental illness.
Supervisor: Stephen O'Connor, Ph.D.

- Conducted individual psychotherapy with adults suffering from multiple comorbid conditions, acute and chronic suicidal ideation, serious health conditions, and disabilities
- Worked collaboratively with psychiatrists to coordinate care
- Conducted suicide assessments and coordinated admission to psychiatric ER
- Attended weekly individual supervision and psychiatry grand rounds
- Co-led weekly DBT skills group for patients with bipolar and borderline personality disorders

Student Therapist ♦ Noble H. Kelley Psychological Services Center, University of Louisville
Louisville, KY (July 2015 – May 2019)
Setting: Psychology department training clinic that provides low-cost psychotherapy and assessment services to students and community.

Eating Disorder Specialty Rotation
Supervisor: Cheri Levinson, Ph.D.

- Provided individual and family psychotherapy to individuals suffering from AN, BN, BED, OSFED, and ARFID
- Conducted intake assessments and made recommendations for appropriate level of care
- Facilitated a weekly eating disorder recovery support group

Mindfulness in Health Rotation
Supervisor: Paul Salmon, Ph.D.

- Provided individual psychotherapy to patients suffering from chronic pain, depression, anxiety, and stress
- Conducted structured intake interviews

- Implemented mindfulness-based treatments, Mindfulness-Based Stress Reduction, and ACT
- Developed individualized case conceptualizations and treatment plans grounded in mindfulness and acceptance theories

Assessment Rotation
Supervisors: David Winch, Ph.D., Bernadette Walter, Ph.D. and Paul Rosen, Ph.D.

- Administered test batteries to assess cognitive functioning, learning disabilities, and psychiatric diagnoses in adults and children
- Adult assessments included: intelligence (WAIS-IV), achievement (Woodcock-Johnson III), personality (MMPI-II, MCMI-III), and psychopathology (SCID, SCID-P, MINI, CPT-III)
- Child assessments included: intelligence (WISC-V), achievement (Woodcock-Johnson III), and ADHD (Conners Comprehensive Behavior Rating Scales, Achenbach Child Behavior Checklist, Vanderbilt Assessment Scale)

CLINICAL SUPERVISION

Advanced Peer Supervisor (August 2020 – Present)
Anxiety Clinic, University of Chicago Medicine

- Supervise advanced clinical psychology extern in delivering cognitive behavioral therapy for anxiety to adults
- Review videotaped session and provide feedback weekly

Advanced Peer Supervisor (June 2019 – April 2020)
Louisville Center for Eating Disorders, Louisville, KY

- Conducted group training on administering eating disorder assessments
- Provided supervision and consultation to therapists on administering eating disorder assessments

Advanced Peer Supervisor (August 2017 – May 2019)
Noble H. Kelley Psychological Services Center, University of Louisville

- Supervised clinical psychology doctoral students in delivering cognitive-behavioral therapy enhanced for eating disorders
- Reviewed videotaped session and provided feedback
- Assisted with case conceptualization and treatment planning

TEACHING & MENTORSHIP

Graduate Student Research Mentor (August 2018 – May 2020)
Department of Psychological and Brain Sciences, University of Louisville

- Undergraduate Senior Honors Thesis

Assessing Perfectionism as a Predictor of Exercise Dependency Over Time
Student: Sarah Ernst

- Undergraduate Independent Research Project (Poster)

Shame, Fear of Food, and Fear of Weight Gain Uniquely Relate to Eating Disorder Psychopathology"
Student: Kaitlyn Coale

- Undergraduate Independent Research Project (Poster)

The Moderating Role of Intolerance of Uncertainty in the Relationship Between Eating Disorders and Fear of Food
Student: Caroline Gates

- Undergraduate Independent Research Project (Poster)

Unique Associations Between Mindfulness Facets and Body Dissatisfaction within Eating Disorder Symptomatology
Student: Alexandra Treager

Graduate Student Supervisor & Instructor (August 2017 – May 2020)
Department of Psychological and Brain Sciences, University of Louisville
Course*:* Eating Disorder Undergraduate Research

- Supervised 4-6 research assistants per semester
- Created syllabus and planned course materials
- Developed guidelines and training materials for research assistants
- Developed and implemented course feedback survey and performance review form
- Conducted weekly lab meetings discussing empirical articles and training in SPSS, literature searches, and RedCap survey systems
- Trained research assistants to conduct all aspects of research
- Met with research assistants to set training goals and provided performance feedback

Peer Mentor for Psychology Doctoral Graduate Students (August 2018 – May 2020)
Department of Psychological and Brain Sciences, University of Louisville

- Assisted new graduate students in adjusting to graduate school and course selection

Lecturer (August - May 2020)
Department of Psychological and Brain Sciences, University of Louisville
Statistics in Psychology

- Held 2 weekly statistics labs for undergraduate students

Graduate Teaching Assistant (August 2017 – May 2020)
Department of Psychological and Brain Sciences, University of Louisville
Cognitive Processes, & Life Span Developmental Psychology

- Administered and graded student exams and other assignments
- Held exam review sessions

AD HOC JOURNAL REVIEWER

International Journal of Eating Disorders: Early Career Scholar Reviewer
Behavior Research and Therapy
Eating Behaviors
Mindfulness
Eating Disorders: The Journal of Treatment & Prevention
Social Psychiatry and Psychiatric Epidemiology

PROFESSIONAL ACTVITIES & SERVICE

Project Parachute Volunteer Leader (March 2019 – Present)
Project Parachute connects healthcare workers on the frontlines of COVID-19 epidemic with pro-bono therapy

- Oversee daily operations of the project
- Manage database of participating therapists (over 300 therapists)
- Supervise a group of matchmaking volunteers
- Coordinate outreach

The Body Project Eating Disorder Prevention Program Facilitator (February 2017 – March 2019)

- Served as a facilitator for an empirically supported body acceptance and dissonance-based eating disorder prevention program in local high schools

Eating Awareness Training Group Facilitator (April 2017 – December 2018)

- Organized and led groups teaching mindful eating skills for University of Louisville faculty and staff

PROFESSIONAL AFFILIATIONS

Academy for Eating Disorders (AED)
Association for Behavior and Cognitive Therapies (ABCT)
American Psychological Association (APA)
Association for Contextual and Behavioral Sciences