

Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

Margaret A. Martinez, M.A.

Date

Mediators and Moderators in a Brief Mobile Intervention
For Disordered Eating

By

Margaret A. Martinez, M.A.
Doctor of Philosophy

Clinical Psychology

Linda W. Craighead, Ph.D.
Advisor

Nancy G. Bliwise, Ph.D.
Committee Member

W. Edward Craighead, Ph.D.
Committee Member

Erin M. Jones, Ph.D.
Committee Member

Lynne C. Nygaard, Ph.D.
Committee Member

Accepted:

Lisa A. Tedesco, Ph.D.
Dean of the James T. Laney School of Graduate Studies

Date

Mediators and Moderators in a Brief Mobile Intervention
For Disordered Eating

By

Margaret A. Martinez, M.A.
B.S., Yale University, 2010
M.A., Emory University, 2014

Advisor: Linda W. Craighead, Ph.D.

An abstract of
a dissertation submitted to the Faculty of the
James T. Laney School of Graduate Studies of Emory University
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in Clinical Psychology
2017

Abstract

Mediators and Moderators in a Brief Mobile Intervention For Disordered Eating

By Margaret A. Martinez, M.A.

Disordered eating is a significant and pervasive problem that is associated with substantial distress and increased risk for the later development of an eating disorder. Data support the efficacy of cognitive-behavioral interventions for disordered eating; however, the reach of existing interventions is limited. Mobile interventions have the potential to improve access to empirically-supported interventions. Before these interventions are widely disseminated, it is critical that we understand how and for whom these interventions are effective. To this end, the present study explores five potential mediators and one moderator of change within a brief, mobile mindful eating intervention targeting young adult women with disordered eating. Proposed mediators included: frequency of eating, change in mindful eating, change in self-compassion, change in emotion regulation, and change in trait mindfulness. Body mass index (BMI) was considered as a possible moderator. Participants were 189 female undergraduate and graduate students (ages 18-30) recruited for a study testing a 3-week mindful eating intervention delivered via an iPhone application (“app”). Analyses of mediation and conditional indirect effects (i.e., moderated mediation) were performed using the PROCESS macro for SPSS (Hayes, 2013), and bootstrapped confidence-intervals were utilized to facilitate statistical inference. Results demonstrated the effectiveness of the intervention in reducing symptoms of disordered eating, including binge eating, dysfunctional cognitions, and preoccupation with eating and weight. Mediation analyses indicated no mediation of the direct effects from pre- to post-intervention symptoms of disordered eating through the proposed mediators with one exception, pre- to post-intervention change in preoccupation eating/weight mediated by frequency of eating. Results indicated that improvement in self-reported mindful eating, and to a lesser extent improvement in self-compassion and emotion regulation, was associated with decreased symptoms of disordered eating whether assessed post-intervention or at a 3-week follow-up. There were interesting differences in the degree to which different variables predicted outcome across various measures of disordered eating. There was no support for the hypothesized moderated mediation of the indirect effects by BMI. Together, these results support the potential utility of brief mindfulness-based interventions, identify some predictors of therapeutic change to explore further, and highlight the importance of including multiple outcome measures in intervention research.

Key words: disordered eating, mindful eating, mHealth, mediators, moderators

Mediators and Moderators in a Brief Mobile Intervention
For Disordered Eating

By

Margaret A. Martinez, M.A.
B.S., Yale University, 2010
M.A., Emory University, 2014

Advisor: Linda W. Craighead, Ph.D.

A dissertation submitted to the Faculty of the
James T. Laney School of Graduate Studies of Emory University
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in Clinical Psychology
2017

Acknowledgements

I am eternally grateful for the support of my family, friends, and colleagues throughout the course of this project and my graduate career. Many, many thanks to my faculty advisor, Dr. Linda Craighead, for her wisdom, guidance, and example. I am also grateful for the assistance of my committee and especially Dr. Nancy Bliwise for lending her statistical expertise to this project. Thanks also to Dr. Lauren Marx for collaborating with me on this project and to our research assistants, Ive Arnaoudova, Kerrigan Cross, Woo Bin Kim, Hannah Lee, Jamie Salzman, Taylor Schaetzle, and Alisha Uppal for their assistance with data collection and entry. Finally, much love and a big thank you to my family and friends for their constant support, encouragement, and love.

Table of Contents

Introduction.....	1
Methods.....	20
Results.....	35
Discussion.....	50
References.....	73
Table 1.....	85
Table 2.....	85
Table 3.....	86
Table 4.....	87
Table 5.....	88
Table 6.....	90
Figure 1.....	91
Figure 2.....	92
Figure 3.....	93
Figure 4.....	94
Figure 5.....	95
Figure 6.....	96
Figure 7.....	97

Introduction

Eating disorders (EDs) are serious psychiatric illnesses with significant costs for both the individual patient and society at large. Although the lifetime prevalence of clinical EDs is relatively low compared to other psychiatric illnesses (ranging from a lifetime prevalence of 0.8% for Anorexia Nervosa, or AN, to a lifetime prevalence of 5% for Binge Eating Disorder, or BED; Hay, Girosi, & Mond, 2015; Smink, van Hoeken, Oldehinkel, & Hoek, 2014; Stice, Marti, & Rohde, 2013), EDs are associated with substantial costs. Medical complications – ranging from cardiac arrhythmias in AN to morbid obesity in BED – are common and can affect virtually all organ systems, resulting in serious and life-threatening complications whose effects may not be reversible (Rome & Ammerman, 2003). Moreover, the incidence of psychiatric comorbidities is high, with more than half of all individuals diagnosed with EDs also receiving a diagnosis of a comorbid illness, and contributes to poor prognosis (Hudson, Hiripi, Pope Harrison G, & Kessler, 2007). Together, the combination of dangerous complications and pervasive comorbidities results in some of the highest mortality rates of any psychiatric illness (Arcelus, Mitchell, Wales, & Nielsen, 2011) and costs to society that rival and even exceed the management of schizophrenia (Agras, 2001).

The prevalence of subclinical eating pathology far exceeds that of diagnosed EDs. Common subclinical presentations of disordered eating include chronic dieting and extreme methods of weight control (e.g., self-induced vomiting; misuse of diuretics, laxatives, or diet pills; fasting); intense preoccupation with food, eating, weight, and/or shape; and self-esteem that is contingent on weight, body shape, or the successful control of these factors. Subthreshold disordered eating occurs with alarming frequency, particularly among high-risk populations such as adolescent and college-aged women.

For instance, data suggest that as many as 55% of adolescent girls are dieting at any given time and that of these, 12% binge eat and 10% engage in extreme methods of weight control (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011). While these behaviors may be intended as short-term means to prevent weight gain, data suggest that use of these extreme and disordered behaviors during adolescence often continues into adulthood (Neumark-Sztainer et al., 2011) and is associated with later weight gain and increased risk for the development of an ED (Neumark-Sztainer et al., 2006; Neumark-Sztainer, Wall, Story, & Standish, 2012).

Among college women, dieting and disordered eating are also extremely common: several studies have found that almost 50% of college women surveyed endorse current dieting and/or report that they engage in disordered behaviors such as binge eating or compensatory behaviors (Berg, Frazier, & Sherr, 2009; Fayet et al., 2012; Krahn, Kurth, Gomberg, & Drewnowski, 2005). Data from the most recent iteration of the Healthy Bodies Study, a national survey of male and female undergraduates at over one hundred institutions (including Emory University, the setting of the current study), suggests that as many as 48% of undergraduates (of both genders) endorse binge eating and 32% endorse some purging in the past month (Lipson & Eisenberg, 2015). The data from the Healthy Bodies Study are even more alarming when only data from female respondents are included, with up to 69% of females endorsing deliberate dietary restraint and as many as 78% expressing concern about their weight and/or shape in the past month (Lipson & Eisenberg, 2015). These high rates of dieting and disordered eating behaviors occur despite the fact that the majority of college women are within the normal weight range, although many perceive themselves to be overweight or obese (Fayet et al., 2012).

As in adolescent females, disordered eating among college-aged women is also persistent over time and associated with increased risk for the later development of an eating disorder (Berg et al., 2009; Eisenberg, Nicklett, Roeder, & Kirz, 2011). In their prospective study of college-aged women, Jacobi and colleagues (2011) found that a history of depression in combination with critical comments about eating from a teacher, coach, or sibling were the most significant risk factors for the development of a clinical or subclinical eating disorder over the course of the 3-year study. Based on their data and those of similar studies, the authors conclude that of the approximately 25% of college women with weight or shape concerns, about one-third are at high risk for the development of subclinical disordered eating and about one-third of these high-risk individuals will convert to a threshold-level eating disorder. That is, in a sample of 1000 college women, 250 will report elevated weight/shape concerns, approximately 83 will develop subclinical but distressing eating pathology, and as many as 27 will develop a clinical eating disorder. When multiplied by the number of women at colleges and universities across the country, these statistics suggest that a staggering number of young women are likely to be affected by disordered eating and EDs.

Empirically-supported treatment of disordered eating

The data summarized above provide compelling evidence of the ubiquity of disordered eating, and to a lesser extent EDs, among adolescent and young adult women. Additionally, data demonstrate that a significant minority of individuals with subthreshold disordered eating will go on to develop full-threshold EDs. Effective interventions are thus of critical importance, both to limit the number of individuals with subthreshold eating pathology who convert to full disorders and to minimize the duration and cost of illness among those with diagnosable EDs. Indeed, data consistently

demonstrate that one of the most robust predictors of good prognosis for EDs is a short duration of illness (e.g., Ackard, Richter, Egan, & Cronemeyer, 2014; Franko et al., 2013), underscoring the need for successful and early intervention.

The last several decades have seen an explosion of new treatments for eating pathology. Interventions for disordered eating now span multiple schools of thought and modalities of delivery, ranging from cognitive remediation therapy (Tchanturia, Lounes, & Holtum, 2014) to interpersonal therapy (Murphy, Straebl, Basden, Cooper, & Fairburn, 2012) to family-based therapy (Loeb, Lock, Greif, & le Grange, 2012). Of these various interventions, Fairburn’s enhanced cognitive-behavioral therapy (CBT-E; Fairburn, 2008), a transdiagnostic intervention intended to treat all major threshold and subthreshold ED presentations, has received the most empirical support. The primary goal of this intervention is to address the core feature of disordered eating: overvaluation of shape, weight, and their control. The treatment attempts to alter this overvaluation by reducing dietary restraint (i.e., the tendency to restrict food intake; Herman & Mack, 1975), which is theorized to be its primary maintaining factor. This is achieved by normalizing eating patterns via self-monitoring of food intake. The establishment of a regular pattern of eating has been described as “fundamental to successful treatment” (Murphy, Straebl, Cooper, & Fairburn, 2010, p. 619), and data support the use of self-monitoring to realize this goal. Indeed, data suggest that self-monitoring of food intake alone may be sufficient to achieve reduction in binge eating among individuals with Bulimia Nervosa (BN) or BED (Barakat et al., 2017; Hildebrandt & Latner, 2006; Latner & Wilson, 2002). The efficacy of self-monitoring extends not only to monitoring of food intake as in CBT-E, but also to self-monitoring of hunger and fullness as in Appetite

Awareness Training (AAT; Craighead, 2006), an empirically-supported alternative to CBT-E.

There is a large body of literature supporting the efficacy of CBT-E for the treatment of disordered eating. Several large clinical trials found that approximately one-half to two-thirds of individuals with diagnosed EDs receiving CBT-E experienced reduction of ED symptoms to within one standard deviation of the community norm (Byrne, Fursland, Allen, & Watson, 2011; Fairburn et al., 2009; Fairburn et al., 2013). Indeed, CBT for BN (a precursor to CBT-E; Fairburn, Marcus, & Wilson, 1993) is the only psychological treatment for EDs to receive an “A” grade from the U.K.’s National Institute for Clinical Excellence (NICE; 2004).

Treatment of disordered eating in the community

Despite strong empirical support for the efficacy of CBT-E and related interventions, relatively few individuals with disordered eating seek formal treatment. Data from the Healthy Bodies Study and others suggest that as few as 20% of individuals who screen positive for an ED seek treatment (Lipson & Eisenberg, 2015; Eisenberg et al., 2011; Hart, Granillo, Jorm, & Paxton, 2011). These numbers may be even smaller among individuals with subclinical disordered eating such as those on university campuses, who are often hesitant to seek treatment and are more likely to seek help for other issues (Schwitzer, 2012; Schwitzer, Rodriguez, Thomas, & Salimi, 2001). Many of these individuals instead express a preference for dealing with their eating issues independently (Lipson & Eisenberg, 2015).

Even when individuals with disordered eating present for treatment, they may or may not receive empirically-supported treatments (ESTs). Data accumulated over the last decade demonstrate that ESTs, including CBT-E, are dramatically underutilized in

community settings such that individuals with EDs are unlikely to receive these “gold-standard” interventions. A recent survey of clinicians in Alberta, Canada found that while between 34-44% of clinicians “often” or “always” use CBT techniques with ED patients, only 23% identified CBT as their primary therapeutic approach (Von Ranson, Wallace, & Stevenson, 2013). Clinicians were most likely to endorse an “eclectic” approach that incorporated techniques from CBT and other techniques with little or no empirical support (e.g., art or narrative therapy; see also Wallace & von Ranson, 2012). Furthermore, when asked to specify the single most important reason for their primary therapeutic approach with ED clients, only 12% cited the treatment’s empirical support. Along with data from several earlier surveys in the United States and Canada (Mussell et al., 2000; Tobin, Banker, Weisberg, & Bowers, 2007; Von Ranson & Robinson, 2006), these results suggest that clinical treatment in the community typically includes only some of the elements of those treatments that have received empirical support.

Data also consistently demonstrate that when delivered in community settings empirically-supported treatments such as CBT are not implemented in the manner in which they have been evaluated (Shafran et al., 2009). Techniques believed to be central to the delivery of manualized CBT-E (e.g., routine weighing, food monitoring) are often omitted in routine clinical use, as reported by both clinicians implementing and patients receiving CBT (Cowdrey & Waller, 2015; Wallace & von Ranson, 2012; Waller, Stringer, & Meyer, 2012). Treatment fidelity does appear to improve with the use of treatment manuals (Waller, Stringer, & Meyer, 2012), but less than half of clinicians choose to use treatment manuals in routine clinical practice (Waller et al., 2013). Clinicians cite a variety of barriers to the use of ESTs, including concerns about inadequate consideration of the therapeutic relationship, perceived inflexibility, clinical

experience that does not support the treatments’ efficacy, and inconsistencies with their own theoretical orientation (Turner, Tatham, Lant, Mountford, & Waller, 2014; Von Ranson et al., 2013). These perceived obstacles to the use of ESTs, in combination a general misunderstanding of the rationale for and implementation of these treatments (Waller, 2009), result in few individuals with eating pathology receiving the gold standard of care in community settings and underscore the need for more successful dissemination of ESTs for EDs.

Dissemination of ESTs for EDs: The importance of considering mechanisms of change

Given concerns about the poor penetration of ESTs (and in particular CBT-E) for disordered eating in routine clinical practice, researchers are calling for improved dissemination of these treatments across the research-practice gap (Cooper & Bailey-Straebler, 2015; Fairburn & Wilson, 2013; Shafran et al., 2009). To this end, the field has seen an increase in the number of self-help interventions for disordered eating and, most recently, interventions that are delivered via the internet or mobile devices. These technology-based interventions have the potential to vastly increase the number of individuals who can benefit from empirically-supported treatments for numerous psychopathologies (Kazdin, 2015), including disordered eating. Moreover, because many mobile interventions are delivered without the assistance of a therapist, the developers have greater control over what treatment strategies are included in the intervention and reach the consumer, thus offering the potential for higher fidelity in the delivery of these interventions. A variety of mobile health, or mHealth, interventions have been developed to address disordered eating, although few of these incorporate components of ESTs for EDs (Juarascio, Manasse, Goldstein, Forman, & Butryn, 2015).

Such apps are already popular and their efficacy should be examined in coming years (Fairburn & Rothwell, 2015). Further examination of the efficacy and effectiveness of mobile interventions is critical given that these interventions have the potential to both increase the reach of ESTs for disordered eating and ensure the delivery of high-fidelity interventions.

However, it is not feasible to simply repackage existing ESTs in the form of a mobile app (nor is doing so likely to be sufficient, given the modest rates of improvement observed in the clinical trials referenced above). That is, existing and future mHealth interventions should not seek to reproduce traditional face-to-face CBT – with all of its various components – on a smartphone or tablet. Rather, in order to create interventions for disordered eating that are both effective and easily-disseminable it is critical that we determine which are the key components or mechanisms of change of ESTs (Murphy, Cooper, Hollon, & Fairburn, 2009; Shafran et al., 2009). These critical mechanisms can then be packaged in interventions that will be more efficient and do not expend effort on elements that are not as necessary or are not helpful. As stated by Kazdin and Nock (2003), the “study of mechanisms of treatment is probably the best short-term and long-term investment for improving clinical practice and patient care (p. 1117), insofar as doing so can help us maximize the efficacy of existing interventions and ensure that they are translated to clinical practice.

Mechanisms of change in eating disorder treatment

Despite the call for research into treatment mechanisms both in the field of eating disorders and in psychotherapy more broadly (Kazdin, 2007, 2009; Kazdin & Nock, 2003; Murphy et al., 2009), the data on this topic are limited. Within the field of eating disorders, only a handful of studies have been published that explicitly investigate

mechanisms of treatment. These studies primarily utilize data from randomized controlled trials of CBT or other ESTs for EDs. For example, Wilson and colleagues (Wilson, Fairburn, Agras, Walsh, & Kraemer, 2002) examined mechanisms of change in a trial comparing CBT to interpersonal therapy (IPT) for BN. They sought to test whether the mechanisms believed to support change in CBT for BN – including reduction of dietary restraint (i.e., development of a regular pattern of eating by increasing the frequency and distribution of eating episodes), increase in eating self-efficacy, and reduction in shape/weight concerns – did in fact mediate the decrease in bingeing/purging from pre- to post-treatment. Of these hypothesized mediators, reduction in dietary restraint was the strongest and most consistent mediator across both treatments; by contrast, improvements in self-efficacy significantly mediated some outcomes but not others. This finding does provide some empirical support for CBT’s emphasis on the importance of establishing a regular pattern of eating but additionally suggests that this is not necessarily a mechanism unique to CBT.

There does appear to be variability in treatment mechanisms across different ED populations. For instance, a study examining mediators of treatment in a study of CBT versus behavioral weight loss (BWL) for BED did not find a mediating effect of reduction in dietary restraint (Dingemans, Spinhoven, & van Furth, 2007). Instead, only a decrease in global eating pathology – driven specifically by a decrease in weight concern – fully mediated the relationship between pre- and post-treatment binge eating. Concern about shape and eating, depressive symptoms, and general psychopathology partially mediated this relationship. By contrast, a study investigating mechanisms of two treatments for adolescent AN (family-based treatment, or FBT, versus Adolescent-Focused Treatment, or AFT) found no significant mediators of treatment effects (Le

Grange et al., 2012). Together, these data suggest that treatment mechanisms may vary both by treatment modality (e.g., individual versus family-based) and intended population (e.g., AN, BN, BED) and highlight the nuances likely to result from this line of inquiry. It is worth noting, however, that there are at present no published data on mediational processes in transdiagnostic CBT-E. This remains a critical avenue for future research, as a way to test the validity of the transdiagnostic theory of EDs and to identify treatment mechanisms.

Predictors and moderators of treatment outcome in EDs

Relatively more work has been done on identifying baseline predictors and moderators of treatment outcome. These data have focused primarily on nonspecific factors such as the therapeutic alliance and motivation to change (Waller, 2012; Zaitsoff, Pullmer, Cyr, & Aime, 2015), as well as on the predictive utility of baseline symptomatology or other pretreatment characteristics (e.g., frequency of bingeing/purging in BN, weight in AN). Briefly, data suggest that the following are the most robust and consistent predictors of good treatment outcome: earlier age of onset and/or shorter duration of illness (Doyle, Le Grange, Loeb, Doyle, & Crosby, 2010; Le Grange et al., 2012; Le Grange, Accurso, Lock, Agras, & Bryson, 2014); lower levels of pre-treatment eating pathology (Fischer, Meyer, Dremmel, Schlup, & Munsch, 2014; Hilbert et al., 2007; Le Grange, Crosby, & Lock, 2008; Thompson-Brenner et al., 2013; Treasure & Russell, 2011; Wagner et al., 2015; Wilson et al., 1999); rapid response to treatment (Doyle et al., 2010; Grilo, White, Masheb, & Gueorguieva, 2015; Le Grange, Accurso, et al., 2014; Munsch, Meyer, & Biedert, 2012; Turner, Marshall, Wood, Stopa, & Waller, 2016; Vall & Wade, 2015); and lower levels of comorbid psychopathology (Accurso et al., 2016; La Mela, Maglietta, Lucarelli, Mori, & Sassaroli, 2013; Le Grange,

Fitzsimmons-Craft, et al., 2014; Wilson et al., 1999). While these data do not speak to how existing treatments are effective, they do provide important information about characteristics of individuals who benefit the most from existing treatments.

In addition to data on non-treatment specific predictors of outcome, there are some limited data on moderator variables that interact with treatment to predict good outcome. Some of the most compelling data come from studies of FBT for adolescents with AN and BN. For adolescents with BN, lower levels of pre-treatment symptoms moderate the response to FBT, such that those individuals with lower pathology are more likely to respond to treatment (Le Grange et al., 2008). Similarly, for adolescents with AN, pre-treatment pathology (and in particular the individual’s level of obsessiveness) moderates response to FBT versus AFT: individuals with higher levels of obsessiveness and eating pathology were more likely to respond to FBT than AFT (Le Grange et al., 2012). However, it is unclear whether these findings generalize to adults with these disorders receiving other treatments.

In the adult treatment literature, there is some indication that subtype, age, and baseline pathology moderate the effect of treatment on outcome. For instance, older individuals with the restricting subtype of AN and higher levels of pathology appear more likely to benefit from CBT versus a supportive control therapy (Le Grange, Fitzsimmons-Craft, et al., 2014). In BN, individuals with higher levels of affective lability and stimulus-seeking benefit more from an emotion-focused treatment (Integrative Cognitive Affective Therapy for BN, or ICAT-BN; Wonderlich et al., 2014) than CBT-E. In BED, there is some evidence that overvaluation of shape/weight moderate the effect of treatment type on outcome, such that individuals with overvaluation had greater reductions in eating pathology and depression if receiving CBT

versus medication (Grilo, Masheb, & Crosby, 2012). While these data are far from conclusive, they are a step towards a more comprehensive understanding of for whom particular treatments are best suited.

Unfortunately, the predictors and moderators evaluated in the literature referenced above likely have little relevance in a subclinical population. Indeed, on many of these variables (e.g., duration of eating pathology, level of comorbid pathology, frequency of disordered behaviors) one would expect a restricted range in a subclinical population, thus limiting their predictive utility. Potential moderators of response to intervention must have greater variability. One such variable that might serve as a moderator in this population is Body Mass Index (BMI). There is considerable variability in BMI among women with subclinical eating pathology, from slightly underweight to mildly or moderately overweight. Clinicians generally agree that differences in BMI can have substantial implications for treatment. For instance, those at the lower end of the BMI range are often characterized by high levels of dietary restraint and self-criticism and need to reduce restraint and increase flexibility and self-compassion as their primary treatment targets; by contrast, those on the higher end of the range are often under-controlled and impulsive and need to reduce overeating. It is thus possible, and perhaps even likely, that response to existing interventions (even those that claim to be transdiagnostic and intended for individuals across the weight spectrum) and the mechanisms of therapeutic change may be moderated by BMI.

The Proposed Study

The proposed study was an attempt to further answer questions of why and for whom treatment for disordered eating is effective. Specifically, the proposed study aimed to evaluate 5 potential mediational mechanisms of change (Aims 1 and 2) and

explored interactions between these hypothesized mediators and one proposed moderator (BMI; Exploratory Aim 1). An additional exploratory aim (Exploratory Aim 2) was to examine mediators of the maintained effects of the intervention. The mediational mechanisms evaluated in the present analyses were drawn from the empirical and theoretical literatures on the treatment of disordered eating and included mechanisms directly targeted by this intervention and hypothesized to facilitate its effects (i.e., frequency of eating, change in mindful eating, and change in self-compassion; Aim 1) as well as broader theoretical constructs (i.e., change in emotion regulation and change in trait mindfulness; Aim 2) that have been directly targeted by other ED interventions. While these broader theoretical constructs are not explicitly targeted by this intervention, their inclusion as potential mediators allowed for a more thorough examination of the mechanisms of this intervention; these findings may in turn inform the development of this and other interventions for this population.

The data for the present analyses come from 189 female university students who self-reported heightened concern with their eating and/or weight. These women were participating in a study of a mindful eating mobile intervention (the “Mindful Eating Coach” app) for the treatment of disordered eating (henceforth to be referred to as the “parent study”). The rationale for this intervention and preliminary effectiveness and acceptability data have been presented elsewhere (Marx, 2016). Briefly, this 3-week mHealth intervention intends to promote mindful eating, and in so doing decrease eating pathology, using an app specifically designed for this study. The focus on mindful eating was chosen based on the hypothesis that such a focus would address some of the typical obstacles to treatment-seeking for university women with disordered eating (Marx, 2016). The app features a variety of tools for the promotion of mindful eating drawn from the

empirical literature on the treatment of disordered eating. These include: psychoeducation on mindful eating and the use of the app, reminders (or “coaching alerts”), self-monitoring of hunger and fullness (per Appetite Awareness Training; Craighead, 2006), self-monitoring of success at eating mindfully, lessons recorded after each eating episode, and the ability to view and track progress.

The primary aims and hypotheses of the study are as follows:

Aim 1: Investigation of intervention-specific mediators (see Figure A1, Appendix A). The primary aim of the present study was to investigate three variables hypothesized to mediate the relationship between pre- and post-intervention symptoms of disordered eating. These variables were: frequency of eating, change in mindful eating, and change in self-compassion.

Frequency of eating. Frequency of eating was included as one of these three proposed mediators based on the centrality of this construct to the cognitive-behavioral treatment of disordered eating. In the cognitive-behavioral model of eating disorders, dietary restraint is believed to be an expression of the individual’s overvaluation of eating, shape, weight, and their control and is the behavior from which all other disordered behaviors originate (Fairburn, Cooper, & Shafran, 2003). Decreasing dietary restraint by increasing the frequency of eating is thus central to existing cognitive-behavioral interventions and has been shown to be a mediator of treatment outcome in at least one study (Wilson et al., 2002). It was thus hypothesized that frequency of eating would mediate the relationship between pre- and post-intervention symptoms in the present study. The current intervention promotes a regular eating pattern by utilizing the appetite rating technique from Appetite Awareness Training (AAT), a cognitive-behavioral intervention that has been shown to produce improvements in eating

pathology (Allen & Craighead, 1999; Craighead & Allen, 1995; Craighead, 2006; Dicker & Craighead, 2004). Appetite awareness training attempts to promote a regular pattern of eating by encouraging individuals to heed their natural hunger and satiety cues and discouraging long periods without eating during which the individual may become too hungry. The app communicates these instructions by coaching participants to “stay in the green,” that is avoid both waiting until one is too hungry to start eating and eating past the point of moderate fullness (see Appendix B).

Mindful eating. As noted, mindful eating is the intended focus of this intervention; it was thus hypothesized that increases in mindful eating would mediate symptom improvement over the course of this intervention. Data from other mindfulness-based interventions for disordered eating (e.g., Mindfulness-Based Eating Awareness Training, or MB-EAT; Kristeller & Wolever, 2010) find that these interventions are associated with improvements in eating pathology. Furthermore, there is some indication that frequency of meditation practice in MB-EAT is correlated with improvement on a variety of measure of eating pathology (Kristeller, Wolever, & Sheets, 2014). However, there are at present no studies that have examined the mediating role of increases in mindful eating on post-treatment improvements in disordered eating. The present intervention directly targets mindful eating by providing individuals with a series of guidelines to “BE MINDFUL” while eating (see Appendix B). These guidelines encourage individuals to make informed decisions whether to eat, to be mindful of hunger and satiety cues while eating, and to remain “tuned in” to the experience of eating. In addition, the app prompts the individual to rate how mindful they were during each eating episode using mindfulness ratings; this feature enables participants to assess their progress and adjust their strategy as needed in order to master mindful eating.

Self-compassion. Finally, it was hypothesized that increases in self-compassion would mediate the relationship between pre- and post-intervention disordered eating. Individuals with disordered eating have been shown to be highly self-critical (Noordenbos, Aliakbari, & Campbell, 2014) and levels of eating pathology are positively correlated with the degree of self-criticism in these individuals (Kelly & Carter, 2013). Interventions that directly target self-criticism by increasing self-compassion have been developed and are associated with corresponding decreases in eating pathology (e.g., Goss & Allan, 2014; Kelly, Carter, & Borairi, 2014; Kelly & Carter, 2014); however, at present there are no data examining whether improvements in eating pathology are mediated by increases in self-compassion. This intervention encourages individuals to assume a mindful and nonjudgmental stance towards all eating episodes, instructing them to “be [their] own cheerleader and avoid criticism.” The lessons tool specifically prompts participants to identify both their successes and areas for improvement after an eating episode, thereby shifting attention away from self-criticism and towards effective and goal-directed behavior. This shift is consistent with a self-compassionate stance: by applying self-compassion, self-criticism is reduced and individuals are better able to process negative feedback or mistakes instead of attempting to defend against them (Neff 2003a, 2003b). Thus, it was hypothesized that increased self-compassion as facilitated by the use of the app’s lessons tool may mediate the effects of the app on eating pathology.

Aim 2: Investigation of theoretical mediators (see Figure A1, Appendix A).

An additional aim of the present study was to investigate the mediating effects of two constructs drawn from the theoretical literature on the treatment of eating disorders.

These were emotion regulation and trait mindfulness.

Emotion regulation. It was hypothesized that increases in emotion regulation would mediate the relationship between pre- and post-intervention disordered eating. Emotion regulation has received increasing attention in recent years following observations of emotion dysregulation across eating disorders (Lavender et al., 2015; Svaldi, Griepenstroh, Tuschen-Caffier, & Ehring, 2012). As such, a number of interventions have been developed that explicitly target emotion dysregulation as a means of decreasing eating pathology (e.g., Safer, Telch, & Agras, 2001; Tchanturia, Doris, & Fleming, 2014; Telch, Agras, & Linehan, 2001; Wildes & Marcus, 2011; Wonderlich et al., 2014). To our knowledge, there are at present no studies that have specifically evaluated whether improvements in emotion regulation mediate improvements in eating pathology. Although this app is not explicitly intended to improve emotion regulation, it may do so indirectly: for instance, in Dialectical Behavior Therapy (DBT; Linehan, 1993), a treatment intended to directly target emotion dysregulation in a variety of populations, behaviors such as regular eating, mindfulness, and self-compassion are all taught as ways to improve emotion regulation. It is thus hypothesized that use of this app – which directly aims to increase the frequency of these behaviors – will result in improvements in emotion regulation and in turn will mediate observed improvements in eating pathology.

Trait mindfulness. It was hypothesized that increases in trait mindfulness – that is, mindfulness that is not specific to the domain of eating– would mediate the relationship between pre- and post-intervention disordered eating. As noted above, the current intervention was designed to increase mindfulness in the context of eating. In so doing it may also produce increases in eating-independent trait mindfulness, although this possibility has not yet been tested. For example, by practicing mindfulness in the context

of eating with the support of the app the individual’s mindfulness practice may generalize to other situations, which could in turn result in increases in trait mindfulness. Data on existing mindfulness-based interventions for disordered eating demonstrate their efficacy in reducing eating pathology (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014) but have not evaluated the mediational role of increases in trait mindfulness.

Exploratory Aim 1: Conditional indirect effects (see Figure A2, Appendix A).

As noted above, symptoms of disordered eating span the full range of weight. The hypothesis that different interventions may be differentially efficacious and may function differently for various individuals has received increasing attention within the field of eating disorders (see Martinez & Craighead, 2015). Weight, or BMI, may be one such variable by which the indirect effects explored in Aims 1 and 2 are conditional. Because there is at present no data exploring moderated mediation by BMI, examination of these conditional indirect effects was included as an exploratory aim in the proposed study.

Exploratory Aim 2: Mediators of maintenance (see Figure A1, Appendix A).

Existing interventions for disordered eating suffer from high rates of relapse post-intervention (e.g., Carter et al., 2012; Grilo et al., 2011; Herzog et al., 1999; Olmsted, MacDonald, McFarlane, Trottier, & Colton, 2015). It is thus essential that we develop a better understanding of by what means treatment effects are maintained after the conclusion of the active intervention, in addition to ascertaining which factors facilitate acute symptom reduction. It is also possible that mediational mechanisms may not be immediately apparent at the end of intervention, consistent with data from a recent study demonstrating that the effects of moderating variables were not evident at the end of a 21-session treatment but were evident at the 4-month follow-up (Accurso et al., 2016);

these findings highlight the need to evaluate mediational mechanisms at multiple time points. As there are at present no studies that evaluate the mediation of change in eating pathology beyond the end of an active intervention, this analysis was included as an exploratory aim in the proposed study.

Final notes. Several points about this intervention and the parent study are worth noting. First, the intervention utilized in the parent study is not intended to be a treatment for clinical EDs. Rather, it is a brief and self-guided intervention delivered via a mobile app for women with subclinical eating pathology. However, the content of this novel intervention intentionally includes some of the elements believed to be central to the successful treatment of clinical EDs, including self-monitoring, problem-solving, and encouragement of a regular pattern of eating. As such, this intervention provides an excellent opportunity to begin to evaluate multiple pathways by which this intervention may reduce eating pathology.

Second, this intervention also differs from existing treatments for eating disorders in its brevity and simplicity, both of which were intended to support its delivery via mobile app to a subclinical population. As a result, its effects and mechanisms of action cannot directly be compared to those of existing psychotherapies. However, the simplicity of this intervention also affords several advantages over more complex interventions. As noted by Murphy and colleagues (2009), most psychotherapeutic interventions are implemented with some flexibility, even in research settings. While this often increases their palatability to patients and clinicians alike, the idiosyncratic application of interventions across individuals weakens our ability to identify common mechanisms of change. By contrast, the stream-lined and compact nature of this intervention maximizes the consistency with which it is applied across individuals: all

participants will be receiving exactly the same intervention presented in precisely the same manner, although their use of it may not be completely identical. This rigidity, in turn, alleviates concerns about treatment adherence and consistency of implementation that plague more complex interventions and allows us to make stronger claims about the mechanisms of change.

Finally, as has been noted previously, the intended audience for this intervention is women with subclinical eating problems. As such, findings of mediation in this intervention may not generalize to other populations (e.g., individuals with diagnosed eating disorders). This is particularly relevant as individuals with clinical eating disorders frequently have comorbid medical and psychiatric diagnoses (Hudson et al., 2007). The presence of comorbidities complicates treatment for disordered eating (Schork, Eckert, & Halmi, 1994; Wilfley et al., 2000) and may make it more difficult to identify mechanisms that contribute to improvements in eating pathology. Data suggest that the type and severity of comorbid psychiatric symptoms increase with the severity of eating pathology such that individuals with subclinical eating pathology tend to have fewer and less severe psychiatric comorbidities (Aspen et al., 2014). The use of women with subclinical eating pathology and presumably lower levels of psychiatric comorbidity thus affords the current study a “cleaner” sample with which to test hypotheses about mediational mechanisms and moderator variables.

Methods

Participants

Participants in the present study were 189 female undergraduate or graduate students at Emory University. Sample demographics are summarized in Table 1.

Potential participants were recruited through flyers placed around the Emory campus and surrounding areas, email announcements made via Emory student listserves, and announcements made (with instructor permission) in undergraduate and graduate courses. All advertisements described the parent study, from which the data for the present analyses were drawn, as a study evaluating an iPhone app that teaches mindful eating strategies. Interested individuals were instructed to email study staff for more information.

Upon initial inquiry by interested individuals, study staff provided a brief overview of the parent study and a screening questionnaire to determine study eligibility via email. This initial email described the study as evaluating a brief mindful eating intervention using a smartphone app that intends to help female students develop a healthier relationship with food and eating. Potential participants were informed of the study design with an emphasis on the participants’ random assignment to receive the app at the first study visit or following a delay of three weeks. Participants were also informed of the duration of study involvement (6 weeks) and commitments of study participation (i.e., attendance at two laboratory sessions and completion of questionnaires at home on one occasion). Of note, interested individuals were explicitly informed that the intervention was not intended to treat eating disorders; all participants were provided with referrals for local treatment providers at first contact and again during the consent discussion. Eligibility criteria (assessed by the screening questionnaire) included: age between 18-30 (inclusive), enrollment as a student at Emory, use of an iPhone* with operating system iOS 8.0 or greater, self-reported distress about eating/weight/shape, willingness to use a mindful eating smartphone app, agreement to random assignment to

* iPhone is a registered trademark of Apple, Inc.

condition, and agreement to abstain from other eating- or weight-focused interventions (including the use of other weight management or food monitoring apps) for the duration of the study.

Individuals who remained interested in study participation after obtaining more information about the study were instructed to complete the screening questionnaire and return it via email to the study staff. Information obtained via the screening questionnaire included contact and demographic information (i.e., date of birth, sex, race/ethnicity, year in school), extent of concern with eating/weight, and current participation in other interventions for disordered eating or weight management. All information obtained in the screening questionnaire was covered by a separate screening consent form attached alongside the screening questionnaire and referral list. Individuals who were eligible for the study based on their responses to the screening questionnaire were scheduled for two study visits.

Procedure

Study participation consisted of two laboratory visits approximately three weeks apart. Each visit lasted approximately 30-60 minutes. Three weeks after the second laboratory visit, participants were emailed a link to complete an online follow-up assessment on their own (outside of the lab). Participants were compensated \$30 after completing the second laboratory visit and \$20 after completing the follow-up assessment. Payments were in the form of Amazon.com gift cards emailed directly to participants. All procedures are described in detail below. A figure depicting the study design and a table illustrating the data collection schedule can be found in Appendix C. All study procedures were approved by the Emory University Institutional Review Board.

Visit 1. Upon arrival to the laboratory for the first study visit, all participants were asked to provide written informed consent. Participants were then asked to complete a series of questionnaires assessing disordered eating, trait and eating-specific mindfulness, emotion regulation, self-compassion, personality, as well as history of prior ED diagnosis, treatment, and experience with similar technology-based interventions. All questionnaires were administered online via the Qualtrics[†] survey platform. Appendix C depicts the collection of self-report data relevant to the present analyses; please note that additional measures collected as part of the parent study but not relevant to the analyses herein have been omitted.

After completing all questionnaires, participants were informed of their group assignment. Group assignment was determined according to a randomization list created using a random number generator. Those individuals randomized to the immediate-intervention condition completed some additional procedures at the first study visit, including instruction in the use of the app as described below. All individuals were reminded of their next study visit and their agreement not to engage in other interventions for the remainder of their study participation prior to leaving the lab.

Visit 2. At visit 2, all participants again completed self-report measures of disordered eating, trait and eating-specific mindfulness, emotion regulation, and self-compassion via Qualtrics. Individuals in the immediate-intervention condition were instructed in how to submit data from their use of the app over the past three weeks to the research staff for later analysis. Individuals in the delayed-intervention condition received instruction in the use of the app at this time. Prior to leaving the lab, all participants were again reminded of their agreement not to engage in other interventions

[†] Qualtrics, LLC

for the remainder of their study participation; they were additionally reminded of the opportunity to complete a final assessment in three weeks for an additional payment (\$20 electronic Amazon.com gift card). Following the completion of all visit 2 procedures, a member of the research staff emailed compensation (\$30 electronic Amazon.com gift card) directly to the participant.

Follow-up Assessment. Approximately three weeks after their second study visit (six weeks since their entry into the study), participants received an email with a link to complete follow-up questionnaires online via Qualtrics. They were again reminded of the opportunity to earn an additional \$20 upon completion of these follow-up assessments. Questionnaires administered at follow-up were identical to those administered at visits 1 and 2 and included measures of disordered eating, trait and eating-specific mindfulness, emotion regulation, and self-compassion. Individuals in both groups were also asked to submit data from their use of the app over the past three weeks to the research staff for later analysis and were instructed in how to do so. Following the receipt of all data from the app and the completion of online questionnaires, a member of the research staff emailed compensation (\$20 electronic Amazon.com gift card) directly to the participant. This concluded all individuals’ study participation.

Data protection and participant privacy. Appropriate steps were taken to preserve participant anonymity and privacy, including the use of anonymous subject identification numbers and secure storage of all electronic and paper data.

Intervention Conditions

For the purposes of the analyses in this study, data from individuals in the immediate-intervention condition (who were required to use the app for the three weeks

between the first and second study visits) and delayed-intervention condition (who were required to use the app for the three weeks between the second study visit and the follow-up assessment) were combined so as to maximize power for the analyses planned for the first and second study aims and the first exploratory aim.

Immediate-intervention condition. As described above, individuals in the immediate-intervention condition received the app and instruction in its use at the first study visit. Participants were instructed to read material that described the rationale for and practice of mindful eating as well as the use of the various tools within the app (see Appendix B). During that visit, they were asked to demonstrate their comfort with the app and had all questions about its purpose or use answered by research staff. Research staff also directed participants to additional material on mindful eating and the use of the app available on the Craighead Lab website (see Appendix D or <http://craigheadlab.weebly.com/mindful-eating-coach-app.html>). They were then instructed to engage in self-guided practice of mindful eating using the app for the next three weeks until they returned to the lab for their second study visit. Participants were asked to practice mindful eating using with the support of the app: 1) whenever they make the decision to eat (i.e., to eat or not eat, deciding what to eat); 2) while eating; and 3) periodically throughout the day to practice “self-coaching” in mindful eating. They were also encouraged to contact the research staff with any questions or issues that arise during their use of the app. Following participation in the second study visit, individuals in the immediate-intervention condition were informed that they were no longer required to use the app for study purposes but could continue using it if they would like.

Delayed-intervention control condition. Individuals in the delayed-intervention control condition received no intervention during the first three weeks of the study (i.e.,

the weeks between visit 1 and visit 2). At visit 2, they received the app and instruction in its use in a procedure identical to that at visit 1 for the immediate-intervention condition: participants were instructed to read instructional material, asked to demonstrate their comfort with its use, and had the opportunity to ask questions of the research staff. They were also informed of the supplementary material available on the Craighead Lab website (see Appendix D). Participants were asked to use the app for the following three weeks (i.e., the weeks between visit 2 and the follow-up assessment) to support them in making mindful decisions to eat, staying mindful while eating, and “self-coaching” throughout the day.

“Mindful Eating Coach” Application

The “Mindful Eating Coach” app was developed and is edited on an as-needed basis by Big Data SME. The purpose of the app is to aid participants in “self-coaching” themselves to eat mindfully. The app contains instructional material on mindful eating and the use of the app (see Appendix B); the steps for the practice of mindful eating are summarized using the acronym “BE MINDFUL” (see Appendix B). This psychoeducational material draws from existing literature on mindful eating and appetite monitoring (Albers, 2005, 2012; Craighead, 2006; Kristeller, Wolever, & Sheets, 2014; Mathieu, 2009; Rossy 2012). To scaffold participants’ practice of mindful eating, the app contains five “coaching tools”: coaching alerts, appetite ratings, mindfulness ratings, lessons, and history.

Coaching alerts. This intervention utilizes reminders, or “coaching alerts,” that prompt participants to practice mindful eating at various points during the day. These alerts are intended to scaffold the practice of mindful eating until it becomes automatic. At the time of the present study, the function to set alerts had not yet been built into the

app; as such, the parent study utilized alerts set via the “Calendar” app available on all iPhones. Alerts appeared as notifications on the lock screen of users’ iPhones; they remain on the screen until the user dismisses them or performs another function on their iPhone. Participants in the parent study were asked to choose four alerts that correspond with their personal goals from a list of 18 provided by the researchers (see Appendix B); these pre-written alerts were written to be consistent with the psychoeducational material provided in the app and capture each of the steps to “BE MINDFUL.” Participants were encouraged to set an alert for first thing in the morning and then at three other times during the day. Participants were instructed to have four alerts set for the duration of their required use of the app, but they were informed that they could change the timing and the content of these alerts if desired.

Appetite ratings. Appetite ratings are the app’s primary tool and allow users to electronically rate the intensity of their hunger and fullness before and after eating. These ratings are one of three tools that participants in the parent study were instructed to use each time they ate. The use of appetite monitoring draws upon practices from Appetite Awareness Training (AAT; Craighead, 2006), a clinical intervention demonstrated to reduce disordered eating in a variety of populations (Allen & Craighead, 1999; Craighead & Allen, 1995; Dicker & Craighead, 2004). In the app, appetite ratings are made on a visual analog scale that ranges from “Too Hungry” to “Too Full” (see Appendices B and Appendix E, Figure E2). The scale used for this intervention mimics the 7-point Likert scale used in AAT. The scale is color-coded such that the extremes of the scale are red, which fades to orange and then becomes green in the middle of the scale; participants are informed that their goal is to “stay in the green,” that is to avoid waiting until they are too hungry to eat and eating beyond the point of moderate fullness.

Participants in the parent study were instructed to rate their appetite before and after each eating episode, with the intention of helping them attend to internal hunger and satiety cues and use this information to guide eating decisions and regulate their eating pattern.

Mindfulness ratings. After completing appetite ratings for each eating episode, users are asked to rate how mindful they were while eating. These mindfulness ratings utilize three icons (see Appendix E, Figure E2): participants select the “sunny” icon if they felt they were able to stay mindful while eating, the “partly cloudy” icon if they felt they were only partly mindful, and the “cloudy” icon if they had difficulty staying mindful. These ratings, along with the lessons described below, are intended to increase users’ awareness of their ability to eat mindfully, reinforce progress, and identify areas for improvement.

Lessons. Finally, after completing mindfulness ratings, users can identify lessons they would like to remember from that eating episode (see Appendix E, Figures E3 and E4). If the user indicates that she ate mindfully, she is asked to indicate what went well by selecting items from a pre-written list (e.g., “Didn’t wait and get too hungry,” or “Ate slowly”). If the user indicates that she had difficulty eating mindfully, she is asked to indicate what she would like to remember to do differently next time by selecting items from a pre-written list (e.g., “Plan ahead to avoid getting too hungry,” or “Remember foods or amounts that didn’t feel good”). Users also have the option to type in personal lessons in addition to selecting from the provided options; these personal lessons are compiled in a list under the app’s history tool for later viewing (see Appendix E, Figure E5). The goal of this tool is to help users learn from and improve upon their past eating experiences, rather than becoming self-critical or feeling guilty. Those negative feelings are hypothesized to interfere with the accurate processing of and subsequent recall of

important information. As noted earlier, theories of self-compassion propose that the reduction of shame and self-criticism allows individuals to process negative information without becoming overwhelmed by it or losing their motivated to change (Neff, 2003a, 2003b).

History. The history tool allows users to track their progress with the aid of several graphs (see Appendix E, Figures E6-E10). These graphs utilize data from the user’s past appetite and mindfulness ratings and allow the user to monitor her progress over time and identify new goals.

Additional coaching resources. The psychoeducational material on mindful eating and the use of the app remains available to users throughout the intervention via the app’s “coaching” tab. This allows users to refer back to this material on an as-needed basis. Additionally, participants in the parent study were informed of the availability of supplemental information available on the Craighead Lab website as noted above (see Appendix D). This supplementary information included a description of the difference between *mindful* and *mindless* eating, an explanation of how mindful eating differs from traditional dieting, instructions on how to adapt self-coaching for personal eating and weight goals, and an example of successful “self-coaching” using the app.

Measures

The data collection timeline is depicted in Appendix C. All self-report measures were completed on laboratory computers using the online Qualtrics[‡] survey platform.

Demographics and history. Using a form developed for the parent study, participants were asked to provide demographic information including their date of birth, racial/ethnic identity, and self-reported height and weight. Participants were also asked

[‡] Qualtrics, LLC

to report on their weight history; current and lifetime ED diagnosis (if applicable); experience with mindfulness meditation, mindful eating, and health/diet/weight loss apps; and reasons for signing up for the study. Data on self-reported current weight and height were taken from this measure to calculate BMI for the moderated mediation analyses of Exploratory Aim 1.

Measures of disordered eating. The following measures were used to assess disordered eating at all three time points.

Dietary Intent Scale (DIS; Stice, 1998). The DIS is a 9-item self-report measure of dietary restraint and includes three subscales: consumption of low-calorie foods, reduced food intake, and abstinence from eating. Items are rated on a 5-point scale from 1 (“Never”) to 5 (“Always”). Higher scores on the DIS denote more severe dietary restraint. Data demonstrate high internal consistency (α 's = 0.93-0.94) and 1-month test-retest reliability ($r = .92$) of the DIS total score and subscales; the measure has also been found to predict a behaviorally-based measure of food intake (Stice, 1998). Internal consistency at each assessment point in the present study point was good (Cronbach's $\alpha = .835-.845$).

Mizes Anorectic Cognitions Questionnaire -- Revised (MAC-R; Mizes, 2000). The MAC-R is a 24-item abbreviated version of the original MAC (Mizes & Klesges, 1989) and is intended to measure agreement with beliefs and attitudes typical of individuals with eating pathology. Items are rated on a 5-point Likert scale ranging from 1 (“Strongly disagree”) to 5 (“Strongly agree”). The MAC-R yields a total score as well as scores on four subscales: Appearance, Weight, and Approval; Self-Control of Eating and Self-Esteem; and Rigid Weight Regulation; and Fear of Weight Gain. Previous research has demonstrated good psychometric properties, including high internal

consistency ($\alpha=.90$). Internal consistency of the total score at each assessment point in the present study was good (Cronbach's $\alpha=.859-.871$).

Binge Eating Scale (BES; Gormally, Black, Daston, & Rardin, 1982). The BES is a 16-item self-report measure that assesses behaviors (e.g., eating large amounts of food), cognitions (e.g., time spent thinking about food), and feelings (e.g., guilt) related to binge eating. Respondents are instructed to select one statement from a group of four that best describes them. Total scores range from 0-46, with higher scores indicating greater severity of behaviors, cognitions, and feelings associated with binge eating. Severe binge eating is indicated by scores ≥ 27 and mild (or absent) binge eating by scores ≤ 17 (Greeno, Marcus, & Wing, 1995). Good test-retest reliability ($r = .87$; Timmerman, 1999) and high internal consistency ($\alpha = .85$; Gormally et al., 1982) have been demonstrated. Internal consistency at each assessment point in the present study was good to excellent (Cronbach's $\alpha=.852-.904$).

Preoccupation with Eating, Weight, and Shape Scale (PEWS; Craighead & Niemeier, 1999; Craighead, Elder, Niemeier, & Pung, 2002). The PEWS is an 8-item self-report measure developed to assess cognitive preoccupation with food/eating and weight/shape. It was adapted from the Modifying Distressing Thoughts Questionnaire (Clark, Feldman, & Channon, 1989). The PEWS is comprised of two subscales: preoccupation with food/eating and preoccupation with weight/shape. Respondents rate on a scale from 1 (“Not at all”) to 6 (“Extremely”) how distressing their thoughts are, how difficult they are to stop, and how much they interfere with concentration. These scores can then be averaged for a preoccupation with food/eating subscale score and a preoccupation with weight/shape subscale score. Additionally, participants are instructed to rate what percentage of the day (0% to 100%) they spend thinking about food/eating

and weight/shape; these ratings are not included in the two subscale scores described above. Higher PEWS scores indicate greater cognitive preoccupation with food/eating and weight/shape. Preliminary analyses of the PEWS suggest adequate sensitivity to change, convergent validity, discriminant validity, and internal consistency ($\alpha = .84$; Niemeier, Craighead, Pung, & Elder, 2002). In the present study, the food/eating and weight/shape subscale scores were averaged to create one total preoccupation score. This score demonstrated good internal consistency at each assessment point (Cronbach's $\alpha = .870-.887$).

Measures of potential mediators. The following measures were used to assess this study's hypothesized mediators.

Ratings of eating habits. This self-report measure, developed by the researchers for the parent study, assesses individuals' engagement in nine habits of mindful eating (e.g., “Pause before eating to consider reasons why I might want to eat besides being hungry,” or “Pay attention to how hungry or full I feel as I'm eating”). Additional questions assess the frequency with which individuals eat various meals and snacks using questions modeled after items on the Eating Disorders Examination (EDE; Fairburn, 2008). In the present study, the frequency of eating items demonstrated unacceptable internal consistency (Cronbach's $\alpha = .416-.457$); as such, this measure was discarded in favor of a total count of app entries made by each participant during the required three weeks of app use. This count was then used to assess frequency of eating episodes over the 3-week intervention period as specified in Aim 1 of the present study. Use of the total number of app entries provides an objective index of the number of eating episodes that is not affected by the limitations of participants' memory. A higher number of entries suggests that a participant did not skip as many meals; however, this value does

not reflect the patterning of eating in terms of which meals might have been skipped or the length of time between eating episodes.

Mindful Eating Scale (MES; Hulbert-Williams, Nicholls, Joy, & Hulbert-Williams, 2014). The MES is a 28-item self-report measure; items are rated on a 4-point Likert scale from 1 (“Never”) to 4 (“Usually”). An exploratory factor analysis of the MES revealed six factors (Hulbert-Williams et al., 2014): acceptance (e.g., “I wish I could control my hunger”), awareness (e.g., “I stay aware of my food whilst I’m eating”), nonreactivity (e.g., “Once I’ve decided to eat, I have to eat straight away”), routine (e.g., “I have a routine for when I eat”), act with awareness (e.g., “I eat automatically without being aware of what I’m eating”), and unstructured eating (e.g., “I snack when I’m bored”). Four of these factors overlap with subscales on general mindfulness measures. In addition to scores on each of these factors, the MES also yields a total score. Higher factor and total MES scores suggest higher levels of mindful eating. The factors have shown adequate internal consistency (α 's = 0.60-0.89), and convergent validity has been demonstrated between these factors and other measures of mindfulness, acceptance, and eating pathology (Hulbert-Williams et al., 2014). Internal consistency of the total score at each assessment point in the present study was good (Cronbach's α =.794-.837). Change in mindful eating over the course of the intervention as measured by the MES total score was used as specified in Aim 1 of the present study.

Self-Compassion Scale (SCS; Neff, 2003). The SCS is a 26-item self-report measure of individuals' self-compassion. Items are rated on a 5-point Likert scale ranging from 1 (“Almost never”) to 5 (“Almost always”). The measure yields a total score as well as scores on six subscales: self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification. Higher scores indicate greater self-

compassion. Previous research has demonstrated good internal consistency ($\alpha=.92$), test-retest reliability (ICCs=.80-.93), and construct and predictive validity (Neff, 2003b) of this measure. Internal consistency of the total score at each assessment point in the present study was excellent (Cronbach’s $\alpha=.944-.950$). Change in self-compassion over the course of the intervention as measured by the SCS total score was used as specified in Aim 1 of the present study.

Difficulty with Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The DERS is a 36-item self-report measure intended to assess multiple aspects of emotion regulation. Each item is scored on a 5-point Likert scale ranging from 1 (“Almost never”) to 5 (“Almost always”). The DERS yields a total score as well as scores on six subscales: non-acceptance of emotions, difficulties engaging in goal-directed behavior, difficulties with impulse control, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Higher scores indicate greater difficulties in emotion regulation. Previous data demonstrate the measure’s high internal consistency ($\alpha=.93$), test-retest reliability (intraclass correlation coefficient=.88), and predictive and construct validity (Gratz & Roemer, 2004). Internal consistency of the total score at each assessment point in the present study was excellent (Cronbach’s $\alpha=.918-.939$). Change in emotion regulation over the course of the intervention as measured by the DERS total score was used as specified in Aim 2 of the present study.

Five-Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Van Dam, Earleywine, & Danoff-Burg, 2009). The FFMQ is a 39-item self-report questionnaire that assesses five facets of a general tendency to be mindful in everyday life: observing (e.g., “I notice the smells and aromas of things”), describing (“I’m good at finding the words to describe my feelings), acting

with awareness (e.g., “I am easily distracted”), nonjudging (e.g., “I criticize myself for having irrational or inappropriate emotions”), and nonreactivity (e.g., “I watch my feelings without getting lost in them”). Respondents are asked to rate how true each item is for them on a 5-point Likert scale from 1 (“Never or very rarely true”) to 5 (“Very often or always true”). The measure yields scores for each of these five subscales as well as a total score. Higher scores denote higher levels of general trait mindfulness.

Convergent and discriminant validity, construct validity (i.e., relationship with meditation experience), and incremental validity of the FFMQ has been demonstrated in several samples (Baer et al., 2006; Baer et al., 2008). All five subscores and the total score have also shown adequate to good internal consistency (α 's = 0.75-0.91; Baer et al., 2006). Internal consistency of the total score at each assessment point in the present study was good (Cronbach's α =.856-.880). Change in trait mindfulness over the course of the intervention as measured by the FFMQ total score was used as specified in Aim 2 of the present study.

Results

All analyses were performed using SPSS version 24.

Data Preparation

Missing data. A small percentage of self-report data was missing (0.065% of self-report data at visit 1; 0.094% of self-report data at visit 2; 0.265% of self-report data at follow-up; 0.129% of all self-report data). Little's test was used to determine that data were missing completely at random for each assessment point ($p_{\text{visit1}}=1.000$; $p_{\text{visit2}}=1.000$; $p_{\text{followup}}=1.000$). Criterion for imputation was set such that if a participant had missed more than 25% of any individual questionnaire, those values were not imputed. The

remaining missing values were imputed using estimation maximization (EM) in SPSS version 24.

Computation of composite variable. A principal components analysis (PCA) was performed to determine whether the various measures of disordered eating (DIS, BES, MAC-R, and PEWS) could be combined into a single composite variable for use in subsequent analyses. Results of this analysis indicated that the DIS, BES, MAC-R, and PEWS total scores loaded onto a single factor at all time points (see Table 2). However, visual examination of the patterns of change over the course of the study and results of preliminary analyses (described below) indicated significant variability across measures. As such, the decision was made to examine each of these measures separately in subsequent analyses so as not to obscure variability in mechanisms of change for each outcome measure.

Residualized change scores. Residualized change scores were computed to represent change in the proposed mediators for use in mediation analyses. As there is no clear consensus on the optimal method of quantifying change in intervention research (Prochaska, Velicer, Nigg, & Prochaska, 2008), the decision to use residualized change scores, rather than simple change scores, was made because residualized changes scores take into account baseline scores and additionally eliminate autocorrelated error and minimize the effects of regression to the mean (Cronbach & Furby, 1970; Kisbu-Sakarya, MacKinnon, & Aiken, 2015; Valente & MacKinnon, 2017). Residualized change scores were computed by regressing the post-intervention score onto the pre-intervention score and saving the standardized residuals. This procedure was used to compute the residualized change score for all proposed mediators assessed by self-report measures (i.e., MES, SCS, DERS, and FFMQ).

Variable transformation. The distribution of BMI in this sample demonstrated significant positive skew (skewness=1.660, standard error=.202; kurtosis=4.218, standard error=.401; $D[144]=.119, p=.000$). A natural log transformation was employed to reduce skewness and kurtosis (skewness=.863; kurtosis=1.408) for use in subsequent moderation analyses.

Preliminary analyses

Demographics. Sample demographics are summarized in Table 1.

Study retention. The consort diagram depicted in Figure 1 demonstrates the flow of participants during the course of study participation. Overall, study retention was high (80%). There were no differences in total number of dropouts ($X^2 [1, N=189]=.29, p=.59$) or timing of dropouts (Likelihood ratio $p=.428$) between the immediate and delayed groups.

Baseline group differences. One-way analyses of variance (ANOVAs) revealed no baseline differences in age ($F[1, 186]=1.446, p=.231, \eta^2_{\text{partial}}=.008$) or baseline BMI ($F[1, 185]=.553, p=.458, \eta^2_{\text{partial}}=.003$) between the immediate and delayed groups. Chi-square analyses additionally revealed no differences in ethnicity ($\chi^2 [1, N=189]=.379, p=.538$), race ($\chi^2 [1, N=189]=1.281, p=.734$), experience with mindfulness/meditation ($\chi^2 [1, N=189]=1.53, p=.242$), experience with mindful eating ($\chi^2 [1, N=189]=1.151, p=.283$), or past self-monitoring experience ($\chi^2 [1, N=189]=.151, p=.697$) between the immediate and delayed groups. Fisher’s exact test was used where the assumptions of Chi-square analyses were violated and additionally indicated that the groups did not differ in history of past ED diagnosis (Fisher’s exact test $p=.719$) or history of past eating- or weight-related treatment (Fisher’s exact test $p=.213$). The groups also did not differ on any of the measures of disordered eating (all $p's > .1$).

Correlations between measures at baseline. Correlations between all measures of disordered eating, proposed mediators, and proposed moderators at baseline are summarized in Table 3.

Intervention effects

The following analyses were performed to assess the effects of the intervention on the measures of disordered eating and all proposed mediators. In particular, these analyses sought to ascertain whether there were any between-group differences that might preclude collapsing across groups as planned. For these analyses, “pre” refers to the assessment immediately prior to the start of app use (i.e., visit 1 for individuals in the immediate group and visit 2 for individuals in the delayed-group), and “post” refers to the assessment immediately following the required 3 weeks of app use (i.e., visit 2 for individuals in the immediate group and the follow-up assessment for individuals in the delayed group).

Effects on disordered eating. A 4 (measure: BES, DIS, MAC-R, and PEWS) by 2 (time: pre-intervention, post-intervention) by 2 (group: immediate, delayed) mixed multivariate analysis of variance (MANOVA) was performed to test the effects of the intervention on the four outcome measures of disordered eating. There were significant main effects of measure ($F[3, 160]=1660.667, p=.000, \eta^2_{\text{partial}}=.969$) and time ($F[1, 162]=32.532, p=.000, \eta^2_{\text{partial}}=.167$), but not of group ($F[1, 162]=.065, p=.799, \eta^2_{\text{partial}}=.000$). Additionally, there was a significant interaction between measure and time ($F[3, 160]=8.897, p=.000, \eta^2_{\text{partial}}=.143$). The interactions between measure and group ($F[3, 160]=.544, p=.653, \eta^2_{\text{partial}}=.010$), time and group ($F[1, 162]=1.240, p=.267, \eta^2_{\text{partial}}=.008$), or measure, time and group ($F[3, 160]=1.694, p=.170, \eta^2_{\text{partial}}=.031$) were not significant. The four measures of disordered eating were moderately correlated in

this study, as expected (see Table 3); as such we had not hypothesized that some measures would respond differentially to the intervention. However, the presence of the significant interaction between measure and time indicated follow-up examination of the intervention effects over time separately for each measure was needed. Follow-up ANOVAs confirmed that there was no main effect of group for 3 of the measures (BES, MAC-R, and PEWS), but there was a significant time by group interaction for the DIS (see Table 4). Paired-samples t-tests (see Table 5) indicated significant improvement from pre- to post-intervention on the first three measures (BES, MAC-R, and PEWS) regardless of when the participants received the intervention. On the DIS only the individuals who received the intervention immediately after their initial assessment – and not those who received it after the 3-week delay – demonstrated significant improvement from pre- to post-intervention. However, it was notable that this delayed group had already shown some reduction in DIS total score (albeit one that was not statistically significant) between visit 1 and visit 2 ($t[91]=1.868, p=.065$), that is before they received the intervention. This nonspecific response to study participation meant that individuals in the delayed group had less room for improvement once using the app and likely explains why the subsequent decrease (while using the app) did not reach statistical significance.

Based on these findings, the decision was made to exclude the DIS from subsequent analyses. As this measure appears to be quite sensitive to demand effects, any results from proposed mediation analyses would be difficult to interpret and could be misleading.

Effects on proposed intervention-specific mediators. A one-way ANOVA was performed on the total number of app entries made during the intervention period (i.e.,

the first of the three proposed intervention-specific mediators) to assess for any differences between groups. Results indicated no significant between-group differences ($F[1, 157]=1.933, p=.166, \eta^2_{\text{partial}}=.012$).

A second 2 (measure: MES, SCS) by 2 (time: pre-intervention, post-intervention) by 2 (group: immediate, delayed) mixed MANOVA was performed to test the effects of the intervention on the remaining two proposed intervention-specific mediators (mindful eating and self-compassion). Results indicated significant main effects of measure ($F[1, 166]=13510.328, p=.000, \eta^2_{\text{partial}}=.988$) and of time ($F[1, 166]=80.723, p=.000, \eta^2_{\text{partial}}=.327$) but not of group ($F[1, 166]=.000, p=.983, \eta^2_{\text{partial}}=.000$). The interaction of measure and time was also significant ($F[1, 166]=75.102, p=.000, \eta^2_{\text{partial}}=.311$). The interactions of measure and group ($F[1, 166]=.049, p=.826, \eta^2_{\text{partial}}=.000$); time and group ($F[1, 166]=.251, p=.617, \eta^2_{\text{partial}}=.002$); or measure, time, and group ($F[1, 166]=.328, p=.568, \eta^2_{\text{partial}}=.002$) were not significant. Post-hoc t-tests on the total sample indicated significant improvements from pre- to post-intervention on the MES and SCS (see Table 5).

Effects on proposed theoretical mediators. A third 2 (measure: DERS, FFMQ) by 2 (time: pre-intervention, post-intervention) by 2 (group: immediate, delayed) mixed MANOVA was performed to test the effects of the intervention on the two proposed theoretical mediators. Results indicated a significant main effect of measure ($F[1, 166]=82.987, p=.000, \eta^2_{\text{partial}}=.333$) but not of time ($F[1, 166]=.001, p=.969, \eta^2_{\text{partial}}=.000$) or group ($F[1, 166]=.1372, p=.243, \eta^2_{\text{partial}}=.008$). The interactions of measure and time ($F[1, 166]=51.173, p=.000, \eta^2_{\text{partial}}=.236$) and of measure, time, and group ($F[1, 166]=5.918, p=.016, \eta^2_{\text{partial}}=.034$) were also significant. The interactions of measure and group ($F[1, 166]=.184, p=.668, \eta^2_{\text{partial}}=.001$) and of time and group ($F[1,$

166]=3.288, $p=.072$, $\eta^2_{\text{partial}}=.019$) were not significant. Post-hoc within-groups t-tests on the total sample indicated significant improvements from pre- to post-intervention on the DERS and FFMQ (see Table 5).

Summary of intervention effects. The results of these analyses demonstrate that there were no between-group differences on any of the outcome measures (with the exception of the DIS) or measures of proposed mediators. Based on these results, subsequent analyses collapsed across groups as planned to maximize power. As noted, this means that data from individuals in the immediate-intervention condition were drawn from the first and second study visits, which represent the time points immediately before and after their 3-week use of the app. Data from individuals in the delayed-intervention control condition were drawn from the second study visit and the follow-up assessment, which represent the time points immediately before and after their 3-week use of the app. In subsequent discussions of analyses proposed to evaluate Aims 1 and 2, “pre-intervention” thus refers to visit 1 for individuals in the immediate-intervention condition and visit 2 for individuals in the delayed-intervention condition while “post-intervention” refers to visit 2 for the immediate-intervention condition and the follow-up assessment for individuals in the delayed-intervention condition.

Aim 1: Mediating effects of the intervention-specific variables

To examine the three proposed mediators outlined in Aim 1, data were subjected to mediation analyses as outlined by Hayes (2013). Specifically, the PROCESS macro for SPSS was used to evaluate each of the mediators outlined in Aim 1 in three parallel mediation models (Model 4; Hayes, 2013), one model for each of the three measures of disordered eating (BES, PEWS, and MAC-R; models 1.1-1.3, depicted in figures 2-4). The decision to run separate models for each of the three measures of disordered eating

was made on the basis of observations of different patterns of change across these three variables, as noted previously. The decision to include all mediators in parallel was made in accordance with the suggestion of Hayes (2013) to protect against an inflation of the Type I error rate.

The PROCESS macro computes: 1) the direct effect of the predictor on the outcome variable (c'); 2) the direct effects of the predictor on each of the proposed mediators ($a_1, a_2 \dots a_k$); 3) the direct effects of each of the proposed mediators on the outcome variable ($b_1, b_2 \dots b_k$); 4) the specific indirect effect(s) through each of the proposed mediator(s) (quantified as the product of the regression coefficients from the predictor variable to the proposed mediator and from the proposed mediator to the outcome variable, or $a_1b_1, a_2b_2 \dots a_kb_k$); 5) and the total indirect effect of the predictor on the outcome variable through all possible mediational pathways using regression models. The macro then facilitates statistical inference to determine the significance of the proposed indirect effect(s) using bias-corrected or percentile bootstrap confidence intervals. Inference testing using bootstrapping methods is widely regarded as the optimal strategy for examining the significance of mediators in relatively small samples, particularly given its ability to accommodate non-normal distributions and subsequent increased power to detect significant effects (Cheung, 2009; A. F. Hayes & Scharkow, 2013; Preacher & Hayes, 2004, 2008). Depictions of both the conceptual and statistical models are presented in Appendix A.

The bootstrapping method employed in the PROCESS macro assumes that the original sample is representative of the population. The original sample is then resampled with replacement n times, which creates a sampling distribution for the statistic at hand (in the case of mediation analyses, the indirect effect of the predictor on

the outcome variable via the proposed mediator). This bootstrapped sampling distribution is then used to construct a confidence interval with which to evaluate the indirect effect: if the confidence interval does not contain zero, then the indirect effect is considered significant. PROCESS allows for the creation of either percentile or bias-corrected confidence intervals. Bias-corrected confidence intervals were used in the present study to increase power to detect an effect and adjust for bias in the bootstrapped sampling distribution. All confidence intervals were created using 10,000 bootstrapped samples of the original data.

Figures 2-4 depict all mediation models performed. In the interest of brevity, only significant associations pertaining to each of the three proposed mediators are described below and summarized in Table 6. Full descriptions of all models performed can be found in Appendix F; additionally, the estimates of each model element are summarized in Tables 1-3 in Appendix G.

Frequency of eating. Frequency of eating was represented in all mediation models by the total number of app entries. The decision to use the total number of app entries to quantify the pattern of eating mediator, rather than the self-reported pattern of eating as originally proposed, was made because of the poor psychometric properties of the Pattern of Eating Questionnaire, as noted earlier.

The total number of app entries mediated only the relationship between pre- and post-intervention preoccupation with eating and weight ($a_1b_1=0.031$; $CI=0.005-0.077$): individuals with higher levels of pre-intervention preoccupation with eating and weight made more app entries ($a_1=3.670$, $p=.004$) and they also reported higher levels of post-intervention preoccupation with eating and weight ($b_1=0.009$, $p=.023$; see Figure 3). Additionally, the path from pre-intervention binge eating to the total number of app

entries was statistically significant ($a_1=0.489$, $p=.025$; see Figure 2), indicating that higher levels of binge eating symptoms were associated with a greater number of app entries during the intervention.

Change in mindful eating. Change in mindful eating was represented in all models as the residualized change on the MES total score from pre-to post-intervention. Change in mindful eating did not mediate any of the relationships between pre- and post-intervention disordered eating. However, change in mindful eating was associated with post-intervention binge eating ($b_2=-2.189$, $p=.000$; see Figure 2), preoccupation with eating and weight ($b_2=-0.327$, $p=.001$; see Figure 3), and dysfunctional cognitions ($b_2=-1.614$, $p=.021$; see Figure 4) such that increases in mindful eating were associated with decreases across all symptom domains.

Change in self-compassion. Change in self-compassion was represented in all models as the residualized change on the SCS total score from pre- to post-intervention. Change in self-compassion did not mediate any of the relationships between pre- and post-intervention measures of disordered eating. Change in self-compassion was associated with post-intervention dysfunctional cognitions ($b_3=-1.520$, $p=.029$; see Figure 4), but not with the measures of binge eating or preoccupation with eating/weight. The directionality of the association suggests that increases in self-compassion over the course of the intervention were associated with decreases in dysfunctional cognitions at the end of the intervention.

Aim 2: Mediating effects of the theoretically-relevant variables

To examine the two additional mechanisms proposed in Aim 2, data were again subjected to mediation analyses using the PROCESS macro (Hayes, 2013). Emotion regulation and trait mindfulness were entered as parallel mediators in three models (again

using Hayes’ Model 4 as the template), one for each of the three measures of disordered eating (BES, PEWS, and MAC-R; models 2.1-2.3, depicted in figures 2-4).

The decision to run a separate model with only the two theoretically-derived mechanisms, rather than running a single model to test all the mediators proposed in Aims 1 and 2, was made to respect the distinction between the three proposed “specific” mechanisms targeted in the intervention (i.e., those in Aim 1) and the two that current theory suggests might be expected to serve as more non-specific mediators in any effective intervention for this population (i.e., those in Aim 2). Because it was unclear whether this second group of mediators would be as likely to demonstrate a significant impact in a brief, limited intervention with a subclinical population, the inclusion of all the variables in a single model would have increased the Type I error rate.

Figures 2-4 depict all mediation models performed. As above, only significant associations pertaining to each of the two proposed mediators are described below; these are also summarized in Table 6. Full descriptions of all models performed can be found in Appendix F; additionally, the estimates of each model element are summarized in Tables 4-6 in Appendix G.

Change in emotion regulation. Change in emotion regulation was represented in all models as the residualized change on the DERS total score from pre- to post-intervention. Change in emotion regulation did not mediate any of the relationships between pre- and post-intervention disordered eating. However, the relationship between change in emotion regulation and post-intervention dysfunctional cognitions was statistically significant ($b_2=2.552, p=.001$; see Figure 4), indicating that increased emotion regulation (i.e., decreases in emotion dysregulation) over the course of the

intervention was associated with decreased dysfunctional cognitions, though not in binge eating or preoccupation with eating and weight, at the end of the intervention.

Change in trait mindfulness. Change in trait mindfulness was represented in all models as the residualized change on the FFMQ total score from pre- to post-intervention. Change in trait mindfulness did not mediate any of the relationships between pre- and post-intervention disordered eating, nor were there any significant associations with pre- or post-intervention disordered eating.

Exploratory Aim 1: Conditional Effects of BMI

To assess the conditional indirect effects of the intervention-specific and theoretically-relevant mediators as a function of BMI, the analyses from aims 1 and 2 were repeated with the natural log of BMI (lnBMI) as a continuous moderator. Hayes’ model 8 (Hayes, 2013) was used as the template for each of these moderated mediation analyses. These analyses examine the moderation of the indirect effects from predictor to outcome variable via the proposed mediators as well the moderation of the direct effect from predictor to outcome variable. Of interest in these models are the interactions between the proposed moderator and the predictor in the paths from the predictor to the proposed mediator (i.e., the indirect effects) and from the predictor to the outcome variable (i.e., the direct effect).

As with the mediation analyses described above, separate models were run for the proposed intervention-specific and the theoretically-relevant mediators and for each of the three measures of disordered eating. This yielded a total of 3 (predictor/outcome variables: BES, PEWS, and MAC-R) x 2 (mediators: intervention-specific, theoretically-relevant) = 6 models.

As above, only significant associations pertaining to the interaction of BMI and the direct and indirect effects are described below. Full descriptions of all models performed along with tables containing the estimates of each model element can be found in Appendices F and G.

Moderating Effects of BMI on Intervention-Specific Mediators

Frequency of eating. There was no evidence of moderation by lnBMI of the indirect effects from pre- to post-intervention disordered eating through the total number of app entries.

Change in mindful eating. There was no evidence of moderation by lnBMI of the indirect effects from pre- to post-intervention disordered eating through the change in mindful eating.

Change in self-compassion. There was no evidence of moderation by lnBMI on the indirect effects from pre- to post-intervention disordered eating through the change in self-compassion.

Moderation of direct effects. There was moderation of the direct effect of pre- on post-intervention binge eating by lnBMI ($c_3' = 0.826, p = .002$; see Table 7 in Appendix G). Probing of the interaction indicated that the direct effect of pre- on post- intervention binge eating increased with lnBMI. The natural log of BMI did not moderate the remaining direct effects.

Moderating Effects of BMI on Theoretically-Relevant Mediators

Change in emotion regulation. There was no evidence of moderation by lnBMI of the indirect effects from pre- to post-intervention disordered eating through the change in emotion regulation.

Change in trait mindfulness. There was no evidence of moderation by lnBMI of the indirect effects from pre- to post-intervention disordered eating through the change in trait mindfulness.

Moderation of direct effects. There was again moderation of the direct effect of pre- on post-intervention binge eating by lnBMI ($c_3' = 0.840$, $p = .005$; see Table 10 in Appendix G). Probing of the interaction indicated that the direct effect of pre- on post-intervention binge eating increased with lnBMI. The natural log of BMI did not moderate the remaining direct effects.

Exploratory Aim 2: Mediating Effects of Intervention-Specific and Theoretically-Relevant Mediators on Short-Term Maintenance

Exploratory aim 2 explored whether changes made on the proposed intervention-specific and theoretically-relevant mediators during the intervention period (as represented as in Aims 1 and 2) mediated the relationship between pre-intervention disordered eating and disordered eating measured at the 3-week follow-up assessment. That is, these analyses were performed to illuminate mediators of the maintained effects of the intervention over a short follow-up period, so as to compare these to mediators of the immediate effects. To this end, the mediation analyses performed for aims 1 and 2 were repeated with disordered eating measured at the follow-up assessment as the outcome variable. Data for this aim were only available from the individuals in the immediate intervention condition. Analyses were again performed separately for each of the three measures of disordered eating (BES, PEWS, and MAC-R). As in the analyses for Aims 1 and 2, Hayes' Model 4 was used as the template (Hayes, 2013) with 10,000 bootstrap samples used to establish bias-corrected bootstrap confidence intervals.

Figures 5-7 depict all mediation models performed. As above, only significant associations pertaining to each of the proposed mediators or contrasts to previous results are described below. Full descriptions of all models performed can be found in Appendix F; additionally, the estimates of each model element are summarized in Tables 13-18 in Appendix G.

Mediating effects of intervention-specific variables on short-term maintenance

Frequency of eating. The total number of app entries did not mediate the relationship between pre-intervention preoccupation with eating and weight and preoccupation at follow-up as it did in the analyses for Aim 1, nor did it mediate the relationships between pre- and post-intervention binge eating or dysfunctional cognitions. Additionally, the path from pre-intervention binge eating to the total number of app entries was no longer statistically significant ($p=.464$) as it was in the analyses for Aim 1.

Change in mindful eating. Change in mindful eating did not mediate any of the relationships between pre-intervention disordered eating and disordered eating at follow-up. Change in mindful eating was again (as in the analyses for Aim 1) associated with follow-up binge eating ($b_2=-1.447$, $p=.019$; see Figure 5) and preoccupation with eating and weight ($b_2=-0.414$, $p=.001$; see Figure 6), such that increases in mindful eating were associated with decreases in these symptom domains at follow-up. Change in mindful eating was no longer associated with dysfunctional cognitions at follow-up ($b_2=-1.125$, $p=.267$), even though it was associated with dysfunctional cognitions at post-intervention.

Change in self-compassion. Change in self-compassion did not mediate any of the relationships between pre-intervention disordered eating and disordered eating at follow-up. Change in mindful eating remained associated with follow-up dysfunctional

cognitions ($b_3=-2.021, p=.039$; see Figure 7), suggesting that increases in self-compassion over the course of the intervention were associated with decreased dysfunctional cognitions at follow-up.

Mediating effects of theoretically-relevant variables on short-term maintenance

Change in emotion regulation. Change in emotion regulation did not mediate any of the relationships between pre-intervention disordered eating and disordered eating at follow-up. The relationship between change in emotion regulation and dysfunctional cognitions at follow-up was no longer statistically significant ($p=.741$) as it was in Aim 2.

Change in trait mindfulness. Change in trait mindfulness did not mediate any of the relationships between pre-intervention disordered eating and disordered eating at follow-up. The relationship between pre-intervention binge eating and residualized change in trait mindfulness during the intervention period was statistically significant ($a_2=-0.030, p=.037$), unlike in the analyses for Aim 2; directionality of the effect suggested that individuals with lower levels of binge eating at baseline demonstrated greater improvements in trait mindfulness over the course of the intervention. However, this change in trait mindfulness during the intervention was not associated with binge eating at the follow-up assessment ($p=.226$).

Discussion

The present study explored mediators and moderators of change within a brief mobile intervention for individuals with disordered eating. Specifically, the effects of five proposed mediators (frequency of eating, eating-specific mindfulness, self-compassion, emotion regulation, and trait mindfulness) and one proposed moderator (BMI) of change in several facets of disordered eating were evaluated in a sample of 189

female university students. These mechanisms were chosen for inclusion in the present study based on prior empirical evidence and theoretical relevance to this intervention and to the treatment of disordered eating more broadly. The intervention (“The Mindful Eating Coach”) features a variety of tools drawn from standard cognitive-behavioral interventions for disordered eating and is delivered via an iPhone app. Results of the present analyses support the effectiveness of the intervention and additionally suggest possible predictors of outcome that warrant further exploration.

Effectiveness of the intervention

Results of the present study add to an earlier report of this intervention’s effectiveness (Marx, 2016). In the present study, improvements were demonstrated in symptoms of disordered eating, including binge eating, preoccupation with eating and weight, and dysfunctional cognitions. On average, participants experienced statistically significant decreases in these domains with small to moderate effect sizes. The effect sizes observed in the present study are comparable to those observed in other self-help mindfulness interventions for other populations (Cavanagh, Strauss, Forder, & Jones, 2014; Spijkerman, Pots, & Bohlmeijer, 2016). Furthermore, the results of this study demonstrate that use of the app was associated with statistically significant improvements in related constructs, including self-reported self-compassion, emotion regulation, and trait (or eating-independent) mindfulness. These findings are in line with existing literature demonstrating the efficacy of self-help interventions for the treatment of disordered eating (see Wilson & Zandberg, 2012).

These results are consistent with a growing body of literature demonstrating the efficacy of mindfulness meditation and mindfulness-based interventions (MBIs) for the treatment of a wide array of psychological and physical illnesses and other problematic

health behaviors in both clinical and non-clinical populations. These include: stress, depression, and anxiety in non-clinical (Khoury, Sharma, Rush, & Fournier, 2015) and clinical samples (Hofmann, Sawyer, Witt, & Oh, 2010; Jain, Walsh, Eisendrath, Christensen, & Cahn, 2015; Vøllestad, Nielsen, & Nielsen, 2012); psychosis (Khoury, Lecomte, Gaudiano, & Paquin, 2013); substance use (Chiesa & Serretti, 2014); somatization disorders (e.g., fibromyalgia, chronic fatigue syndrome, and irritable bowel syndrome; Lakhan & Schofield, 2013); immune functioning (Black & Slavich, 2016); as well as disordered eating behaviors (e.g., binge, emotional, and external eating; O'Reilly, Cook, Spruijt-Metz, & Black, 2014) and weight-loss (Olson & Emery, 2015). This abbreviated list demonstrates the mounting body of evidence in support of mindfulness practices, although researchers still caution that mindfulness should not be viewed a panacea for all ails (Goyal et al., 2014). Caution is especially warranted as in many studies mindfulness practices are embedded within broader interventions, which results in relatively little evidence to delineate the potentially unique or specific effects of mindfulness practices.

The practice of mindfulness meditation, and meditation more broadly, is viewed by many as intimidating to learn and as having a steep learning curve. Indeed, these practices have historically been taught in by means of participation in intensive retreats (see Khoury, Knäuper, Schlosser, Carrière, & Chiesa, 2017 for a discussion of the data in support of traditional meditation retreats) and/or via direct, often individual, instruction from an experienced practitioner or guru. Both formats suggest that mindfulness practice requires intensive training. This substantial time commitment serves to limit the number of individuals who might benefit from such a practice.

By contrast, results of this study support an alternative view that at least some applications of mindfulness practice – such as mindful eating – can be taught in a self-guided format and are associated with demonstrable behavioral change. This conclusion is consistent with several recent meta-analyses of online mindfulness- and acceptance-based interventions (Cavanagh et al., 2014; Spijkerman et al., 2016). As in the present study, both of those meta-analyses found significant increases in mindfulness and/or acceptance and significant decreases in psychological symptoms (e.g., stress, depression, anxiety), suggesting that mindfulness can, in fact, be primarily self-taught.

Of note, the interventions included in the meta-analyses by Cavanaugh and colleagues (2014) and Spijkerman and colleagues (2016) were delivered via the internet, books, or audio recordings. That a similar pattern of results was found following the use of the app-based mobile intervention featured in the present study – which provided significantly less instruction and required less time than any of the interventions included in those meta-analyses – is particularly of note. These findings suggest that not only can mindfulness be self-taught, but it can be self-taught in the form of a relatively low-intensity and cost-effective intervention such as a mobile app and may require only a minimal amount of instruction and scaffolding to facilitate meaningful change in behavior. Indeed, many app developers have acted on this assumption even before there was data to support it, as is evidenced by the vast number of mindfulness-based apps currently available (Mani, Kavanagh, Hides, & Stoyanov, 2015; Plaza, Demarzo, Herrera-Mercadal, & García-Campayo, 2013). Most of these apps have not been empirically evaluated; as such, the present study makes a significant contribution to an area lacking in data. The present results support the effectiveness of mindfulness-based strategies for the amelioration of disordered eating habits through the use of this

particular app; further research is needed to confirm the effectiveness of other mindfulness-based mobile interventions currently available to the public.

Both the meta-analysis by Cavanaugh and colleagues (2014) and the one by Spijkerman and colleagues (2016) reported larger effect sizes for guided as compared to unguided self-help interventions. This observation is consistent with the research on guided versus unguided self-help interventions for clinical eating disorders, particularly for the treatment of BED and to a lesser extent BN. As noted in several meta-analyses and systematic reviews, self-help interventions can be effective in reducing symptoms of disordered eating, but they are more effective when guidance from a professional is included (Beintner, Jacobi, & Schmidt, 2014; Perkins, Murphy, Schmidt, & Williams, 2006; Traviss-Turner, West, & Hill, 2017). As one qualitative study noted, guides serve to encourage and support participants in self-help interventions and also to increase motivation and challenge behavior when necessary (Traviss, Heywood-Everett, & Hill, 2013). These observations are supported by the results of a meta-analysis by Beintner and colleagues (2014), who found that the addition of professional guidance to self-help interventions improved both treatment adherence and outcomes, with higher completion rates and larger intervention effects observed among guided self-help interventions.

A review of qualitative data obtained from participants as part of the larger study from which these data were drawn indicated that over half of the participants using this app stated that meeting or speaking with a counselor or therapist would have been at least moderately helpful. Of those who expressed such a desire, the majority expressed a preference for brief (i.e., less than 30 minute) in-person meetings with a counselor or therapist, followed by email exchanges, group meetings, brief phone calls, and lastly longer (i.e., 45-60 minutes) individual meetings. Participants noted that contact with a

counselor or therapist would help them remain engaged with the intervention and increase accountability; review the instructional information provided through the intervention; implement individualized suggestions for changing eating behavior; identify the origins of their difficulties with food and reasons for disordered eating behaviors; trouble-shoot difficulties encountered during the course of the intervention; provide positive reinforcement for successful behavior change and validation regarding difficulties encountered; and identify patterns and progress in their behavior using the history feature. One participant noted that, “I sometimes felt like I was regularly not being mindful at a particular time of day and while I was aware that I was not being mindful, I didn’t know how to stop it...meeting with a professional once a week may have been helpful in that.” Another participant noted that, “The app is a good idea, but [has] no human components...So, it was hard to find motivation to use [the app]. If I could [talk to] a therapist, and we had together set a goal for me to use [the app], I may have been more dedicated to using the app.” These observations are consistent with those of the participants in the Traviss and colleagues (2013) qualitative study described above. Thus, given the literature demonstrating greater effect sizes for guided as compared to unguided self-help interventions and the qualitative reports obtained from participants in this and other studies, the addition of a guided component to this and similar self-guided mobile interventions may increase the effectiveness of such interventions. This may be particularly true for individuals with greater eating pathology, such as those with clinical eating disorders. Future research should explore this critical question.

Mediation and moderation of change

The present analyses found limited support for the study hypotheses with one exception: the total number of app entries made during the 3-week intervention period mediated the relationship between pre- and post- preoccupation with eating and weight, but not the other two outcome measures, i.e. binge eating and dysfunctional cognitions. There was no evidence that any of the remaining proposed mediators mediated the relationship between pre- and post-intervention measures of binge eating, preoccupation with eating and weight, or dysfunctional cognitions. Additionally, there was no evidence of moderated mediation by BMI, although there was some indication that BMI moderated the direct effects between pre- and post-intervention binge eating.

It is perhaps not surprising that the present study found limited evidence of mediation through any of the proposed mediators, neither those specifically targeted by the intervention (i.e., frequency of eating, mindful eating, and self-compassion) nor the two non-specific constructs drawn from the theoretical literature on the treatment of disordered eating (i.e., emotion regulation and trait mindfulness). Other treatment studies in the field of eating disorders have similarly failed to confirm hypothesized mediational pathways (e.g., Le Grange et al., 2012), and numerous authors have discussed at length the difficulties entailed in demonstrating mediation in intervention research, often because of limitations in study design (Kazdin, 2007, 2009; Kazdin & Nock, 2003; Kraemer, Wilson, Fairburn, & Agras, 2002; Stice, Presnell, Gau, & Shaw, 2007; Stice, Rohde, Seeley, & Gau, 2010). It is thus likely that some of the limitations of this study's design (discussed below) contributed to our failure to confirm hypothesized mediational pathways.

It is additionally of note that where successful mediation has been explored in interventions for EDs, the mediating variables chosen differed from those evaluated in

the present study. For instance, studies of eating disorder prevention programs have examined the mediating role of thin-ideal internalization (Seidel, Presnell, & Rosenfield, 2009; Stice et al., 2007; Stice, Presnell, Gau, & Shaw, 2009). Other studies with clinical populations have examined such potential mediators as self-esteem, self-efficacy, weight concern, and coping style (e.g., Dingemans et al., 2007; Le Grange et al., 2012), with mixed results. Future studies should aim for consistency across proposed mechanisms so as to improve our ability to compare results across studies and populations.

The one exception to this study’s limited support for hypothesized mediational pathways was the finding that the total number of app entries mediated the relationship between pre- and post-intervention preoccupation with eating and weight, such that a greater number of app entries was associated with increased preoccupation at the end of the 3-week intervention. This finding is consistent with clinical observations that self-monitoring often increases preoccupation in the short term. For instance, in the manual for CBT-E, the “gold standard” treatment for EDs, Fairburn (2008) recommends that clinicians warn patients of the short-term negative effects of self-monitoring by stating, “I should forewarn you that self-monitoring will have a short-term negative effect. It will make you more preoccupied with your eating, but this only lasts a week or so and is worth it” (p. 57). Fairburn’s notion of the eventual dissipation of the deleterious effects of self-monitoring on preoccupation with eating and weight was in fact supported by the results of the present study: the total number of app entries made during the intervention did not mediate the relationship between pre-intervention preoccupation and preoccupation at the follow-up assessment, as demonstrated in model 4.2a. Thus, while self-monitoring using the Mindful Eating Coach app may be associated with increased preoccupation with eating and weight modestly over the course of 3 weeks of active use

of the app, these effects do appear to dissipate, as would be expected according to Fairburn (2008).

Even in the relative absence of statistically significant mediation, results of this study do indicate that change in certain variables is associated with improvement in symptoms of disordered eating following the intervention. In particular, these data suggest that improvements in mindful eating, and to a lesser extent improvements in self-compassion and emotion regulation, over the course of the intervention were associated with decreased binge eating, preoccupation with eating and weight, and dysfunctional cognitions at post-test. It is of note that there was limited indication in these data of a relationship between baseline symptoms and change in these variables (which precludes the possibility of demonstrating statistical mediation of the relationship between pre- and post-intervention symptoms). That is, these results would seem to suggest that the changes an individual is able to achieve during the intervention are an important determinant of post-intervention disordered eating above and beyond disordered eating symptoms at baseline. This finding is encouraging and suggests that this intervention may be helpful for individuals with a range of disordered eating symptoms. However, it is important to note that the present study only included individuals with relatively low levels of symptoms, so further research is needed to examine the effectiveness of this intervention with more symptomatic individuals.

In the present study, increases in mindful eating was the most consistent predictor of reduction in symptoms of disordered eating. This is encouraging for multiple reasons. First and foremost, this finding serves as a manipulation check. Our intention in the development of this intervention was to increase mindful eating and in so doing to facilitate change across multiple facets of disordered eating; results of this study suggest

that we were successful in accomplishing both of these goals. Furthermore, these data demonstrate that the application of mindfulness practice to eating was associated with a reduction in disordered eating behaviors and attitudes, thus supporting previous research on the benefits of mindful eating interventions in clinical and subclinical samples (Kristeller & Wolever, 2010; Kristeller et al., 2014; Mathieu, 2009).

The last several years have seen increased interest in the mechanisms of MBIs. Exploration of this question has focused primarily on Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002), Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1994) and to a lesser extent Acceptance and Commitment Therapy (ACT; Hayes & Wilson, 1994) and Dialectical Behavior Therapy (DBT; Linehan, 1993), as these are the MBIs with the most empirical support. The developers of these treatments generally suggest that mindfulness practice allows the practitioner to recognize and disentangle him- or herself from habitual and maladaptive patterns of cognition and behavior. This process is sometimes referred to as “decentering” and is theorized to facilitate symptom improvement. Multiple authors have proposed and evaluated a number of potential mechanisms by which MBIs achieve this “decentering” effect. These include increased mindfulness (that is, awareness of the present moment without judgement; Kabat-Zinn, 2003); increased self-compassion; increased emotion regulation; increased psychological flexibility; increased self-efficacy; decreased cognitive and emotional reactivity; and decreased repetitive negative thinking (Bogosian, Hughes, Norton, Silber, & Moss-Morris, 2016; Cavanagh et al., 2014; Chambers, Gullone, & Allen, 2009; Chiesa, Anselmi, & Serretti, 2014; Gu, Strauss, Bond, & Cavanagh, 2015; Kuyken et al., 2010; Shapiro, Carlson, Astin, & Freedman, 2006).

A recent meta-analysis by Gu and colleagues (2014) found the most robust empirical support for decreases in cognitive and emotional reactivity as mechanisms of MBIs, moderate support for increases in mindfulness and decreases in rumination and worry, and only preliminary support for increases in self-compassion and psychological flexibility. Thus, the findings of the present study appear to be in line with broader research on the mechanisms of MBIs. In particular, our findings that increases in mindful eating and to a lesser extent self-compassion and emotion regulation were associated with improvements in disordered eating (and the maintained effects of the intervention after a brief follow-up period) are consistent with data demonstrating the importance of those changes in other MBIs and for the treatment of a wide variety of psychological and physical illnesses. In short, these data suggest that this mobile mindful eating intervention may achieve its effects by means similar to MBIs for other problematic behaviors.

Variability across symptom domains

Results of the present analyses also demonstrated some interesting variability across different facets of disordered eating. This study intentionally included four separate measures that assess different facets of disordered eating: dietary restraint (as measured by the DIS; Stice, 1998), binge eating (as measured by the BES; Gormally, Black, Daston, & Rardin, 1982), preoccupation with eating and weight (as measured by the PEWS; Craighead & Niemeier, 1999; Craighead, Elder, Niemeier, & Pung, 2002), and dysfunctional cognitions (as measured by the MAC-R; Mizes, 2000). Our original intent was to combine these into a composite variable that encompassed multiple components of disordered eating, thus creating a single variable that would be more representative of the multi-faceted nature of disordered eating. However, preliminary

analyses indicated distinct variability in response to the intervention across these four measures. While participants evidenced a significant decrease in symptoms over the course of the intervention on the majority of these measures, regardless of whether the intervention was introduced immediately or after a delay of 3 weeks, one (the DIS) did not. As noted previously, women in the immediate-intervention group did report significant decreases in dietary restraint over the course of the intervention, but this decrease did not reach significance for women in the delayed-intervention group while they were participating in the active intervention. Additional analyses revealed that women in the delayed-intervention group had reported some (nonsignificant) decreases in dietary restraint both initially, while waiting to receive the intervention, as well later after having received the intervention. Thus, change in the DIS total score in this group cannot be attributed to the intervention. We hypothesize that the change on the DIS prior to the initiation of the intervention reflects more of a non-specific effect, such as increased hope from the knowledge that they would soon receive the intervention. The discrepancy between the DIS and the other measures of disordered eating included in the present study is worth noting as it suggests that perhaps this measure is more sensitive to demand characteristics than the others, questions the validity of this measure as a measure of outcome, and raises the possibility that self-reported dietary restraint responds to intervention in a different way or on a different time course than other aspects of disordered eating. Given these concerns, this measure was excluded from subsequent analyses.

Even among the three measures that were retained as valid symptom indicators, subsequent analyses revealed different relationships between these variables and the proposed mediators and moderator. For instance, whereas increases in mindful eating

predicted more favorable outcomes in binge eating, preoccupation with eating and weight, and dysfunctional cognitions, increases in self-compassion and emotion regulation were only associated with improvements in dysfunctional cognitions.

Similarly, BMI moderated the direct effect of pre- on post-intervention binge eating but not preoccupation with eating and weight or disordered cognitions. Together, these discrepancies suggest that change in the various facets of eating pathology is likely promoted by distinct mechanisms. Increasing one’s ability to be mindful while eating may help reduce binge eating, preoccupation with eating and weight, and dysfunctional cognitions; by contrast, increasing one’s self-compassion may help challenge disordered cognitions but do little to reduce binge eating or preoccupation with eating and weight. In other words, “disordered eating” is not a single unitary construct. Rather, it consists of distinct components that may respond differently to a particular intervention and may be affected by unique mechanisms.

The implications of this observation are multiple. First and foremost, the observed discrepancies in the present study between measures assumed to tap different facets of a single latent variable (i.e., disordered eating) supports the use of multiple outcome measures in clinical research, particularly in intervention research, and suggests caution when creating composite variables. The vast majority of clinical trials report outcomes for only one or two variables. In the eating disorder intervention literature, these are often an objective measure (i.e., weight, number of binge episodes) and an interview or questionnaire measure of global eating pathology (i.e., total score on the either the interview- or questionnaire-version of the Eating Disorder Evaluation; Fairburn & Beglin, 1994; Fairburn, 2008; or the Eating Disorders Inventory; Garner, Olmstead, & Polivy, 1983). When investigators are interested in exploring subordinate constructs,

scores on the various subscales of these measures are explored. The results presented here suggest that this approach may be insufficient, particularly for questions of mediation, moderation, and predictors of outcome or change. Use of global measures or composite variables may obscure important variability in patterns, mechanisms, and timing of change.

Additionally, the discrepancies in predictors of change across various facets of disordered eating observed in the present study suggest promising avenues to pursue in treatment development as the field attempts to personalize and thus improve the effectiveness of our clinical interventions. Individuals vary greatly in the symptoms of disordered eating they display. Having information about which interventions produce change in which symptoms of disordered eating and by what mechanisms, as in the present study, may help us better match interventions to affected individuals. For instance, if an individual struggles with binge eating that appears to be largely the product of mindless eating, results of the present study suggest that this intervention may be of benefit to them, as the intervention was particularly successful in reducing those symptoms. By contrast, an individual who struggles with preoccupation with eating and weight that is driven by deficits in self-compassion may not find this intervention as effective. That individual may require another intervention, perhaps one that more directly addresses these symptoms.

The process of matching treatments to symptoms, not underlying “diseases,” is akin to the treatment of complex medical pathologies. For instance, there is no single pill for heart disease. Rather, the treatment of cardiovascular disease requires multiple pharmacologic interventions corresponding to the individual patient’s unique clinical presentation. Pharmacologic interventions may include antihypertensive medications to

control high blood pressure, HMG-CoA reductase inhibitors (or statins) to reduce cholesterol, and aspirin to reduce platelet aggregation. Best practice also requires that comorbid conditions that increase risk – such as diabetes, obesity, or smoking – be addressed using pharmacologic and/or psychosocial intervention. Thus, a single patient with cardiovascular disease may find him or herself receiving multiple interventions, each intended to treat one component of their disease, as part of the treatment of what is conceptualized as a single illness. Placed in the context of psychiatric illness, this might mean that an individual with an eating disorder such as bulimia nervosa receives a behavioral therapy to facilitate a normal pattern of eating, a cognitive therapy to address disordered beliefs, a mindfulness-based intervention to address cognitive and/or emotional reactivity, and pharmacologic interventions to address underlying neurobiological vulnerabilities.

Of course, it is unfeasible for a single patient with a psychiatric illness to participate in multiple manualized psychotherapies to address his or her particular constellation of symptoms. The move towards modular, transdiagnostic treatments – which allow clinicians to build custom psychotherapies by sequencing a variety of mini-interventions, or modules (see Chorpita, Daleiden, & Weisz, 2005) – offers one solution to this particular problem. Indeed, Fairburn’s “enhanced” CBT for eating disorders (CBT-E; Fairburn, 2008), which has the greatest empirical support of any psychotherapy for the treatment of eating disorders, is transdiagnostic in focus and offers several optional modules that can be added to the standard treatment to address contributing factors (i.e., perfectionism, low self-esteem, and interpersonal difficulties). Future research is needed to better understand whether this alternate approach to psychotherapy does in fact afford advantages over more traditional manualized therapies. However,

both a vast body of literature supporting CBT-E for the treatment of disordered eating and the results of the present study highlight the value of exploring and treating symptoms, rather than syndromes, an aim that is often overlooked by researchers in their quest to identify the “best” treatment for a particular disorder.

Strengths and limitations

The present study has several notable strengths. Paramount among these is the use of a more appropriate and robust statistical methodology for assessing mediation and conditional indirect effects. As noted in a recent review by Gu and colleagues (2015), the majority of mediation studies published continue to use the outdated “causal-steps” method proposed by Baron and Kenny three decades ago (1986). While the Baron and Kenny causal-steps approach is intuitive and easy to execute, it has serious limitations including an inflation of the Type I error rate as described elsewhere (Hayes, 2013). Moreover, the causal-steps approach does not quantify the indirect effect, nor does it provide any means for inference about its significance. The use of Hayes’ PROCESS macro for the computation and evaluation of indirect effects in the present study thus represents a significant methodological advance over previous studies. This methodology is particularly advantageous given this study’s relatively small sample size: the use of bootstrapped confidence intervals, as in the present study, maximizes statistical power in smaller samples while still controlling error rates.

Additionally, the analyses described herein assess a total of five proposed mediators, each grounded in theory and empirical research, as well as the conditional indirect effects as a function of BMI. Both of these decisions are in accord with recommendations by Kazdin and others (Alsubaie et al., 2017; Kazdin & Nock, 2003; Laurenceau, Hayes, & Feldman, 2007). Alsubaie and colleagues (2017) note in their

recent review that many mediation studies consider only a single mediator and do not consider the interactions between mediational pathways and individual difference variables. The inclusion of multiple mediators in the present study, additional analysis of conditional indirect effects, and independent analysis of the effects of these variables across different facets of disordered eating are the attempts of this author to address these limitations. These design and analytic decisions allowed the present study to evaluate the effects of a mediator while accounting for the effects of other, conceptually-related variables. Additionally, the separation of analyses for each dimension of disordered eating assessed in the present study allowed for the identification of both shared and unique predictors of change across these outcome variables, as has been advocated elsewhere (Laurenceau et al., 2007). Finally, the proposed mediators and the proposed moderator were identified a priori in the present study and are theoretically and conceptually distinct from the outcome variables, a necessary but often overlooked prerequisite for mediation analyses (Kraemer et al., 2002).

There are several limitations of the present study that must be noted. Chief among these is the lack of temporal precedence in the experimental design: because the proposed mediators were assessed at the same time point as the outcome variables (i.e., pre- and post-intervention), we cannot exclude the possibility of reverse causality. That is, it is possible that change in symptoms of disordered eating facilitated change in mindful eating, self-compassion, emotion regulation, and trait mindfulness. Moreover, because of the limitations of the study design, we cannot establish any causal relationship between the proposed mediating variables and change in disordered eating. Even in the cases when change in one of the proposed mediating variables was associated with

decreases in disordered eating post-intervention, this is a statistical association only – we cannot say definitively that the former caused the latter.

The limitations of assessing mediation and moderation in the context of pre-post designs have been extensively discussed in the literature (Alsubaie et al., 2017; Kazdin, 2007, 2009; Kazdin & Nock, 2003; Kraemer et al., 2002; Laurenceau et al., 2007). Often, as in the present study, analysis of mediators and moderators of therapeutic change are attempts to identify mechanisms of change. This is a critical avenue of inquiry, as noted previously. However, the distinction between “mechanism” and “mediator” must be made explicit. The term “mechanism” is used to refer to “those processes or events that lead to and cause therapeutic change” (Kazdin & Nock, 2003, p. 1117). By contrast, a mediator refers to “an intervening variable that may account (statistically) for the relationship between the independent and dependent variable,” which “may be a guide that points to possible mechanisms but is not necessarily a mechanism” itself (Kazdin, 2007, p. 3). That is, the term “mediator” refers only to a statistical relationship that may or may not be indicative of underlying mechanisms.

The criteria necessary to identify a mediator versus a mechanism of therapeutic change vary substantially. In order to establish statistical mediation, hypothesized mediator variables need not be measured at separate time points than predictor and outcome variables, although doing so strengthens the argument that an identified mediator is in fact a mechanism of change. By contrast, there is a general consensus in the field that establishing a variable or construct as a mechanism of therapeutic change does require that the hypothesized mechanism be measured at multiple time points over the course of the intervention such that the investigator can establish that change in the proposed mechanism occurred prior to and facilitated change in the outcome variable

(i.e., that there is temporal precedence; Kazdin, 2007, 2009; Kazdin & Nock, 2003; Kraemer et al., 2002; but see Murphy, Cooper, Hollon, & Fairburn, 2009 for an argument in favor of measuring proposed mediators at the same time point as outcome variables for therapeutic interventions that are best conceptualized as a cohesive unit, rather than a sequence of procedures).

Analyses that identify statistical mediators or predictors of change in therapeutic interventions, such as those described in the present study, are not without merit. As noted by Kraemer and colleagues (2002), these analyses serve a valuable function in hypothesis-generation insofar as they identify possible candidates for mechanisms of therapeutic change. However, further research is needed to test these hypotheses; that is, to establish that it is via these avenues that the intervention is effective and that change in hypothesized mediators are not simply correlates of therapeutic change (i.e., Kraemer et al., 2002). To establish this, more sophisticated research designs are required that meet the criteria outlined by Kazdin and others (Kazdin, 2007, 2009; Kazdin & Nock, 2003; Kraemer et al., 2002). These include assessment of the proposed mechanisms at multiple time points throughout the intervention (not just before and after) and/or so-called component studies that separate and experimentally manipulate theorized “active ingredients” of the intervention in question. These research designs, in combination with more sophisticated statistical techniques such as growth curve modeling or hierarchical linear modeling, will aid significantly our quest to identify not only mechanisms of therapeutic change but the time course of change and individual differences therein (Laurenceau et al., 2007). Further analysis of the large amount of data obtained from participants’ use of the app in the present study (which includes appetite and mindfulness

ratings for each eating episode recorded) using these statistical techniques presents a promising avenue may be one step towards these research goals.

Because of the correlational nature of the present analyses and our reliance on self-report data, the present study offers limited understanding of how changes in mindful eating, self-compassion, and emotion regulation were achieved. These data demonstrate that changes in these variables were reported by participants and that those changes were associated with decreases in a range of self-reported symptoms of disordered eating; however, we are unable to determine based on these data how participants were able to achieve these changes (e.g., what specific behaviors participants engaged in that helped them eat more mindfully, etc.). In addition to the use of more sophisticated research designs that can illuminate the nuances of therapeutic change, evaluation of qualitative feedback from study participants may also aid in our understanding of how interventions such as this one facilitate change (M. Allen, Bromley, Kuyken, & Sonnenberg, 2009; Bogosian et al., 2016; Chittaro & Vianello, 2016; Grossman, 2008, 2011). For instance, numerous participants in the present study indicated that the intervention helped them attune to their hunger and fullness sensations, suggesting that interoceptive awareness (and in particular awareness of hunger and satiety signals) may be one possible mechanism of this intervention. Future research might attempt to isolate the unique contributions of this mindfulness to physical sensations by isolating this component of the intervention. This could be done either by manipulating the content of the intervention so that it only includes appetite monitoring (as in Jones, 2012) or by altering the instructions provided to participants so that there is an exclusive focus on attending to hunger/satiety cues rather than a broader focus on eating mindfully, as was provided in

the present study. To this end, laboratory-based experimental studies may be particularly informative.

Additional limitations of the present study include a relatively small sample size for the type and number of analyses performed. Although the use of resampling methods, such as that employed by PROCESS, was an attempt to minimize the effects of a small sample on statistical power, there is still the possibility of Type II errors. Furthermore, while collapsing across both the immediate- and delayed-intervention groups served to increase our sample size and boost power, this decision meant that we were unable to utilize a control condition in these analyses and thus limits the conclusions that can be drawn. The changes in disordered eating and proposed mediators that were observed in the present study cannot be unequivocally attributed to the intervention itself without a more sophisticated design and/or a larger sample. Future studies with larger sample sizes could maintain the distinction between experimental and control group and use group as the predictor, rather than pre-intervention symptoms as in the present study (Kazdin, 2007, 2009; Kazdin & Nock, 2003; Kraemer et al., 2002).

Finally, the sample in the present study included only university women with elevated eating and weight but largely subclinical concerns. As such, the generalizability of the present results to other populations (e.g., clinical samples, men, adolescents) is limited. Future research can and should evaluate the efficacy of this intervention for these populations and continue to explore mediators of treatment effects. These lines of research are likely to be particularly relevant for self-guided interventions such as this one: in the absence of those factors common to traditional psychotherapies, it seems especially likely that individual differences will affect both the effectiveness and

mechanisms of these interventions. The moderated mediation analyses described as part of Exploratory Aim 1 of the present study provide some limited suggestion of this.

In addition to examining the effectiveness and mechanisms of this intervention in other populations, future research would do well to examine the utility of other delivery methods (e.g., with the addition of some professional support in the form of a guided self-help intervention) and/or the effectiveness of this intervention for different aims (e.g., for the prevention of eating disorders in vulnerable populations, or as an adjunct to more intensive psychotherapies for clinical eating disorders). The integration of this and other empirically-supported self-help interventions within a stepped care model for the prevention and treatment of eating disorders is a particularly promising avenue for future research, particularly given the considerable cost savings offered by stepped care models in university populations (Kass et al., 2017; Wilfley, Agras, & Taylor, 2013).

These avenues of inquiry need to be approached with the necessary caution, however, particularly when evaluating the effectiveness of self-help “e-health” interventions for clinical populations, among whom there is greater pathology and greater risk of adverse outcome. That is, we cannot assume that because this and similar interventions may be effective in a subclinical population they would be similarly effective in clinical populations, particularly given the limited empirical support that exists at present (Aardoom, Dingemans, Spinhoven, & Furth, 2013; Cooper & Bailey-Straebler, 2015; Dölemeyer, Tietjen, Kersting, & Wagner, 2013; Loucas et al., 2014). Regardless of the population the intervention is applied to, or the purpose for which it is utilized, examination of this and other mobile self-help interventions should be subjected to the same empirical rigor as traditional psychotherapies (Loucas et al., 2014).

Conclusion

The results of the present study confirm the effectiveness of this brief, self-guided mobile intervention for university women with disordered eating. Use of the “Mindful Eating Coach” app over a period of three weeks was associated with significant decreases in various symptoms of disordered eating (binge eating, preoccupation with eating and weight, and dysfunctional cognitions) and with improvements in proposed mediators (mindful eating, self-compassion, emotion regulation, and trait mindfulness). Mediation analyses demonstrated little formal mediation, although change in several of the proposed mediators was associated with more favorable outcomes at the end of the three-week intervention period. In particular, improvement in self-reports of mindful eating was associated with improvement on all measures of disordered eating, while improvements in self-compassion and emotion regulation were only associated with improvements on the measure of disordered cognition. These correlational results suggest that these variables may facilitate change in this intervention, but additional research is needed to further evaluate this hypothesis. Given the enormous potential offered by mobile interventions to extend the reach of evidence-based interventions and increase access to quality care, continued rigorous examination of the effectiveness and mechanisms of these interventions is warranted.

References

- Aardoom, J. J., Dingemans, A. E., Spinhoven, P., & Furth, E. F. Van. (2013). Treating Eating Disorders Over the Internet: A Systematic Review and Future Research Directions. *International Journal of Eating Disorders*, *46*(6), 539–552. <http://doi.org/10.1002/eat.22135>
- Accurso, E. C., Wonderlich, S. A., Crosby, R. D., Smith, T. L., Klein, M. H., Mitchell, J. E., ... Peterson, C. B. (2015). Predictors and Moderators of Treatment Outcome in a Randomized Clinical Trial for Adults with Symptoms of Bulimia Nervosa. *Journal of Consulting and Clinical Psychology*, *84*(2): 178-184.
- Ackard, D. M., Richter, S., Egan, A., & Cronemeyer, C. (2014). Poor outcome and death among youth, young adults, and midlife adults with eating disorders: An investigation of risk factors by age at assessment. *International Journal of Eating Disorders*, *47*(7), 825–835. <http://doi.org/10.1002/eat.22346>
- Agras, W. S. (2001). The consequences and costs of the eating disorders. *Psychiatr Clin North Am*, *24*(2), 371–379.
- Allen, H. N., & Craighead, L. W. (1999). Appetite Monitoring in the Treatment of Binge Eating Disorder. *Behavior Therapy*, *253*–272.
- Allen, H. N., & Craighead, L. W. (1999). Appetite monitoring in the treatment of Binge Eating Disorder. *Behavior Therapy*, *30*(2), 253–272.
- Allen, M., Bromley, A., Kuyken, W., & Sonnenberg, S. J. (2009). Participants’ Experiences of Mindfulness-Based Cognitive Therapy: “It Changed Me in Just about Every Way Possible.” *Behavioural and Cognitive Psychotherapy*, *37*(4), 413. <http://doi.org/10.1017/S135246580999004X>
- Alsubaie, M., Abbott, R., Dunn, B., Dickens, C., Keil, T., Henley, W., & Kuyken, W. (2017). Mechanisms of action in mindfulness-based cognitive therapy (MBCT) and mindfulness-based stress reduction (MBSR) in people with physical and/or psychological conditions: A systematic review. *Clinical Psychology Review*, *55*(August 2016), 74–91. <http://doi.org/10.1016/j.cpr.2017.04.008>
- Arcelus, J., Mitchell, A. J., Wales, J., & Nielsen, S. (2011). Mortality rates in patients with anorexia nervosa and other eating disorders: a meta-analysis of 36 studies. *Arch Gen Psychiatry*, *68*(7), 724-731.
- Aspen, V., Weisman, H., Vannucci, A., Nafiz, N., Gredysa, D., Kass, A. E., ... Taylor, C. B. (2014). Psychiatric co-morbidity in women presenting across the continuum of disordered eating. *Eating Behaviors*, *15*(4), 686–693. <http://doi.org/10.1016/j.eatbeh.2014.08.023>
- Barakat, S., Maguire, S., Surgenor, L., Donnelly, B., Miceska, B., Fromholtz, K., ... Touyz, S. (2017). The Role of Regular Eating and Self-Monitoring in the Treatment of Bulimia Nervosa: A Pilot Study of an Online Guided Self-Help CBT Program. *Behavioral Sciences*, *7*(3), 39. <http://doi.org/10.3390/bs7030039>
- Baron, R. M., & Kenny, D. a. (1986). The Moderator-Mediator Variable Distinction in Social The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. <http://doi.org/10.1037/0022-3514.51.6.1173>
- Beintner, I., Jacobi, C., & Schmidt, U. H. (2014). Participation and outcome in manualized self-help for bulimia nervosa and binge eating disorder — A systematic review and metaregression analysis. *Clinical Psychology Review*, *34*(2), 158–176. <http://doi.org/10.1016/j.cpr.2014.01.003>
- Berg, K. C., Frazier, P., & Sherr, L. (2009). Change in eating disorder attitudes and behavior in college women: Prevalence and predictors. *Eating Behaviors*, *10*(3), 137–142.

- <http://doi.org/10.1016/j.eatbeh.2009.03.003>
- Black, D. S., & Slavich, G. M. (2016). Mindfulness meditation and the immune system: a systematic review of randomized controlled trials. *Annual New York Academy of Science*, 1373(1), 13–24. <http://doi.org/10.1111/nyas.12998>
- Bogosian, A., Hughes, A., Norton, S., Silber, E., & Moss-Morris, R. (2016). Potential treatment mechanisms in a mindfulness-based intervention for people with progressive multiple sclerosis. *British Journal of Health Psychology*, 21(4), 859–880. <http://doi.org/10.1111/bjhp.12201>
- Byrne, S. M., Fursland, A., Allen, K. L., & Watson, H. (2011). The effectiveness of enhanced cognitive behavioural therapy for eating disorders: An open trial. *Behaviour Research and Therapy*, 49(4), 219–226. <http://doi.org/10.1016/j.brat.2011.01.006>
- Carter, J. C., Mercer-Lynn, K. B., Norwood, S. J., Bewell-Weiss, C. V., Crosby, R. D., Woodside, D. B., & Olmsted, M. P. (2012). A prospective study of predictors of relapse in anorexia nervosa: Implications for relapse prevention. *Psychiatry Research*, 200(2–3), 518–523. <http://doi.org/10.1016/j.psychres.2012.04.037>
- Cavanagh, K., Strauss, C., Forder, L., & Jones, F. (2014). Can mindfulness and acceptance be learnt by self-help?: A systematic review and meta-analysis of mindfulness and acceptance-based self-help interventions. *Clinical Psychology Review*, 34(2), 118–129. <http://doi.org/10.1016/j.cpr.2014.01.001>
- Chambers, R., Gullone, E., & Allen, N. B. (2009). Mindful emotion regulation: An integrative review. *Clinical Psychology Review*, 29(6), 560–572. <http://doi.org/10.1016/j.cpr.2009.06.005>
- Cheung, M. W.-L. (2009). Comparison of methods for constructing confidence intervals of standardized indirect effects. *Behavior Research Methods*, 41(2), 425–438. <http://doi.org/10.3758/BRM.41.2.425>
- Chiesa, A., Anselmi, R., & Serretti, P. A. (2014). Psychological Mechanisms of Mindfulness-Based Interventions: What Do We Know? *Holistic Nursing Practice*, 28(2), 124–148. <http://doi.org/10.1097/HNP.0000000000000017>
- Chiesa, A., & Serretti, A. (2014). Are Mindfulness-Based Interventions Effective for Substance Use Disorders? A Systematic Review of the Evidence. *Substance Use & Misuse*, 49(5), 492–512. <http://doi.org/10.3109/10826084.2013.770027>
- Chittaro, L., & Vianello, A. (2016). Mobile Mindfulness and User’s Worry: A Qualitative Study of Using a Smartphone App for Distancing from Negative Thoughts. *Interacting with Computers*, 28(6), 695–717. <http://doi.org/10.1093/iwc/iwv044>
- Chorpita, B. F., Daleiden, E. L., & Weisz, J. R. (2005). Modularity in the design and application of therapeutic interventions. *Applied and Preventive Psychology*, 11(3), 141–156. <http://doi.org/10.1016/j.appsy.2005.05.002>
- Cooper, Z., & Bailey-Straebl, S. (2015). Disseminating Evidence-Based Psychological Treatments for Eating Disorders. *Current Psychiatry Reports*, 17(3). <http://doi.org/10.1007/s11920-015-0551-7>
- Cowdrey, N. D., & Waller, G. (2015). Are we really delivering evidence-based treatments for eating disorders? How eating-disordered patients describe their experience of cognitive behavioral therapy. *Behaviour Research and Therapy*, 75, 72–77. <http://doi.org/10.1016/j.brat.2015.10.009>
- Craighead, L. W. (2006). *The appetite awareness workbook: How to listen to your body and overcome bingeing, overeating, and obsession with food*. Oakland, CA: New Harbinger Publications, Inc.
- Craighead, L. W., & Allen, H. N. (1995). Appetite awareness training: A cognitive behavioral

- intervention for binge eating. *Cognitive and Behavioral Practice*, 2(2), 249–270.
- Cronbach, L. J., & Furby, L. (1970). How we should measure “change” - or should we? *Psychological Bulletin*, 74(1), 68–80. <http://doi.org/10.1037/h0029382>
- Dicker, S. L., & Craighead, L. W. (2004). Appetite-focused cognitive-behavioral therapy in the treatment of binge eating with purging. *Cognitive and Behavioral Practice*, 11(2), 213–221.
- Dingemans, A. E., Spinhoven, P., & van Furth, E. F. (2007). Predictors and mediators of treatment outcome in patients with binge eating disorder. *Behaviour Research and Therapy*, 45(11), 2551–2562. <http://doi.org/10.1016/j.brat.2007.06.003>
- Dölemeyer, R., Tietjen, A., Kersting, A., & Wagner, B. (2013). Internet-based interventions for eating disorders in adults: A systematic review. *BMC Psychiatry*, 13, 207–222.
- Doyle, P. M., Le Grange, D., Loeb, K., Doyle, A. C., & Crosby, R. D. (2010). Early response to family-based treatment for adolescent anorexia nervosa. *International Journal of Eating Disorders*, 43(7), 659–662. <http://doi.org/10.1002/eat.20764>
- Eisenberg, D., Nicklett, E. J., Roeder, K., & Kirz, N. E. (2011). Eating Disorder Symptoms Among College Students: Prevalence, Persistence, Correlates, and Treatment-Seeking. *Journal of American College Health*, 59(8), 700–707. <http://doi.org/10.1080/07448481.2010.546461>
- Fairburn, C. G. (2008). *Cognitive Behavior Therapy and Eating Disorders*. New York, NY: Guilford Press.
- Fairburn, C. G., & Beglin, S. J. (1994). Assessment of eating disorders: interview or self-report questionnaire? *Int J Eat Disord*, 16(4), 363–370.
- Fairburn, C. G., Cooper, Z., Doll, H. A., O’Connor, M. E., Bohn, K., Hawker, D. M., ... Palmer, R. L. (2009). Transdiagnostic Cognitive-Behavioral Therapy for Patients With Eating Disorders: A Two-Site Trial With 60-Week Follow-Up. *Am J Psychiatry*, 166(3), 311–319.
- Fairburn, C. G., Cooper, Z., Doll, H. A., O’Connor, M. E., Palmer, R. L., & Dalle Grave, R. (2013). Enhanced cognitive behaviour therapy for adults with anorexia nervosa: A UK–Italy study. *Behaviour Research and Therapy*, 51(1), R2–R8. <http://doi.org/10.1016/j.brat.2012.09.010>
- Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: a “transdiagnostic” theory and treatment. *Behav Res Ther*, 41(5), 509–528.
- Fairburn, C. G., Marcus, M. D., & Wilson, G. T. (1993). Cognitive-behavioral therapy for binge eating and bulimia nervosa: a comprehensive treatment manual. BT - Binge eating: nature, assessment and treatment. In C. G. Fairburn & G. T. Wilson (Eds.), *Binge eating: nature, assessment and treatment* (pp. 361–404). New York: Guilford Press.
- Fairburn, C. G., & Rothwell, E. R. (2015). Apps and eating disorders: A systematic clinical appraisal. *International Journal of Eating Disorders*, 48(7), 1038–1046. <http://doi.org/10.1002/eat.22398>
- Fairburn, C. G., & Wilson, G. T. (2013). The dissemination and implementation of psychological treatments: Problems and solutions. *International Journal of Eating Disorders*, 46(5), 516–521. <http://doi.org/10.1002/eat.22110>
- Fayet, F., Petocz, P., & Samman, S. (2012). Prevalence and correlates of dieting in college women: a cross sectional study. *International Journal of Women’s Health*, 4, 405–11. <http://doi.org/10.2147/IJWH.S33920>
- Fischer, S., Meyer, A. H., Dremmel, D., Schlup, B., & Munsch, S. (2014). Short-term Cognitive-Behavioral Therapy for Binge Eating Disorder: Long-term efficacy and predictors of long-term treatment success. *Behaviour Research and Therapy*, 58, 36–42. <http://doi.org/10.1016/j.brat.2014.04.007>
- Franko, D. L., Keshaviah, A., Eddy, K. T., Krishna, M., Davis, M. C., Keel, P. K., & Herzog, D.

- B. (2013). Do mortality rates in eating disorders change over time? A longitudinal look at Anorexia Nervosa and Bulimia Nervosa. *American Journal of Psychiatry*, *170*(8), 917–925. <http://doi.org/10.1176/appi.ajp.2013.12070868>
- Garner, D. M., Olmstead, M. P., & Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *International Journal of Eating Disorders*, *2*(2), 15–34.
- Goss, K., & Allan, S. (2014). The development and application of compassion-focused therapy for eating disorders (CFT-E). *British Journal of Clinical Psychology*, *53*(1), 62–77. <http://doi.org/10.1111/bjc.12039>
- Goyal, M., Singh, S., Sibinga, E., Gould, N., Rowland-Seymour, A., Sharma, R., ... Al, E. (2014). Meditation programs for psychological stress and well-being : a systematic review and meta-analysis. *JAMA Intern Med*, *174*(3), 357–68. <http://doi.org/10.1001/jamainternmed.2013.13018.Meditation>
- Grilo, C. M., Masheb, R. M., & Crosby, R. D. (2012). Predictors and moderators of response to cognitive behavioral therapy and medication for the treatment of binge eating disorder. *Journal of Consulting and Clinical Psychology*, *80*(5), 897–906. <http://doi.org/10.1037/a0027001>
- Grilo, C. M., Pagano, M. E., Stout, R. L., Markowitz, J. C., Ansell, E. B., Pinto, A., ... Skodol, A. E. (2011). Stressful life events predict eating disorder relapse following remission: Six-year prospective outcomes. *International Journal of Eating Disorders*, *45*(2), 185–192.
- Grilo, C. M., White, M. A., Masheb, R. M., & Gueorguieva, R. (2015). Predicting Meaningful Outcomes to Medication and Self-Help Treatments for Binge-Eating Disorder in Primary Care : The Significance of Early Rapid Response. *Journal of Consulting and Clinical Psychology*, *83*(2), 387–394.
- Grossman, P. (2008). On measuring mindfulness in psychosomatic and psychological research. *Journal of Psychosomatic Research*, *64*, 405–408.
- Grossman, P. (2011). Defining Mindfulness by How Poorly I Think I Pay Attention During Everyday Awareness and Other Intractable Problems for Psychology’s (Re)Invention of Mindfulness: Comment on Brown et al . (2011). *Psychological Assessment*, *23*(4), 1034–1040. <http://doi.org/10.1037/a0022713>
- Gu, J., Strauss, C., Bond, R., & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical Psychology Review*, *37*, 1–12. <http://doi.org/10.1016/j.cpr.2015.01.006>
- Hart, L. M., Granillo, M. T., Jorm, A. F., & Paxton, S. J. (2011). Unmet need for treatment in the eating disorders: A systematic review of eating disorder specific treatment seeking among community cases. *Clinical Psychology Review*, *31*(5), 727–735. <http://doi.org/10.1016/j.cpr.2011.03.004>
- Hay, P., Girosi, F., & Mond, J. (2015). Prevalence and sociodemographic correlates of DSM-5 eating disorders in the Australian population. *Journal of Eating Disorders*, *3*(1), 19. <http://doi.org/10.1186/s40337-015-0056-0>
- Hayes, A. F., & Scharkow, M. (2013). The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis: does method really matter? *Psychological Science*, *24*(10), 1918–1927. <http://doi.org/10.1177/0956797613480187>
- Hayes, S. C., & Wilson, K. G. (1994). Acceptance and commitment therapy: Altering the verbal support for experiential avoidance. *The Behavior Analyst*, *17*(2), 289–303.
- Herman, C. P., & Mack, D. (1975). Restrained and unrestrained eating. *Journal of Personality*, *43*(4), 647–660. <http://doi.org/10.1111/j.1467-6494.1975.tb00727.x>

- Herzog, D. B., Dorer, D. J., Keel, P. K., Selwyn, S. E., Ekeblad, E. R., Flores, A. T., ... Keller, M. B. (1999). Recovery and relapse in anorexia and bulimia nervosa: a 7.5-year follow-up study. *J Am Acad Child Adolesc Psychiatry, 38*(7), 829–837.
- Hilbert, A., Saelens, B. E., Stein, R. I., Mockus, D. S., Welch, R. R., Matt, G. E., & Wilfley, D. E. (2007). Pretreatment and process predictors of outcome in interpersonal and cognitive behavioral psychotherapy for binge eating disorder. *J Consult Clin Psychol, 75*(4), 645–651.
- Hildebrandt, T., & Latner, J. (2006). Effect of Self-Monitoring on Binge Eating: Treatment Response or “BingeDrift”? *22*, 17–22.
- Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 78*(2), 169–183. <http://doi.org/10.1037/a0018555>
- Hudson, J. I., Hiripi, E., Pope Harrison G, J., & Kessler, R. C. (2007). The Prevalence and Correlates of Eating Disorders in the National Comorbidity Survey Replication. *Biol Psychiatry, 61*(3), 348–358.
- Jacobi, C., Fittig, E., Bryson, S. W., Wilfley, D., Kraemer, H. C., & Taylor, C. B. (2011). Who is really at risk? Identifying risk factors for subthreshold and full syndrome eating disorders in a high-risk sample. *Psychological Medicine, 41*(9), 1939–1949. <http://doi.org/10.1017/S0033291710002631>
- Jain, F. A., Walsh, R. N., Eisendrath, S. J., Christensen, S., & Cahn, B. R. (2015). Critical Analysis of the Efficacy of Meditation Therapies for Acute and Subacute Phase Treatment of Depressive Disorders: A Systematic Review. *Psychosomatics, 56*(2), 140–152. <http://doi.org/10.1016/j.psych.2014.10.007>
- Jones, E. M. (2012). Electronic apps for food and appetite monitoring: Acceptability and reactive effects in women with eating and weight concerns (Doctoral dissertation).
- Juarascio, A. S., Manasse, S. M., Goldstein, S. P., Forman, E. M., & Butryn, M. L. (2015). Review of Smartphone Applications for the Treatment of Eating Disorders. *European Eating Disorders Review, 23*(1), 1–11. <http://doi.org/10.1002/erv.2327>
- Kabat-Zinn, J. (1994). *Wherever You Go, There You Are*. New York, NY: Hyperion Books.
- Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*(2), 144–156. <http://doi.org/10.1093/clipsy/bpg016>
- Kass, A. E., Balantekin, K. N., Fitzsimmons-Craft, E. E., Jacobi, C., Wilfley, D. E., & Taylor, | C Barr. (2017). The economic case for digital interventions for eating disorders among United States college students. *International Journal of Eating Disorders, 50*(3), 250–258. <http://doi.org/10.1002/eat.22680>
- Katterman, S. N., Kleinman, B. M., Hood, M. M., Nackers, L. M., & Corsica, J. A. (2014). Mindfulness meditation as an intervention for binge eating, emotional eating, and weight loss: A systematic review. *Eating Behaviors, 15*(2), 197–204. <http://doi.org/10.1016/j.eatbeh.2014.01.005>
- Kazdin, A. E. (2007). Mediators and Mechanisms of Change in Psychotherapy Research. *Annual Review of Clinical Psychology, 3*(1), 1–27. <http://doi.org/10.1146/annurev.clinpsy.3.022806.091432>
- Kazdin, A. E. (2009). Understanding how and why psychotherapy leads to change. *Psychotherapy Research, 19*(4–5), 418–428. <http://doi.org/10.1080/10503300802448899>
- Kazdin, A. E. (2015). Technology-Based Interventions and Reducing the Burdens of Mental Illness: Perspectives and Comments on the Special Series. *Cognitive and Behavioral Practice, 22*(3), 359–366. <http://doi.org/10.1016/j.cbpra.2015.04.004>

- Kazdin, A. E., & Nock, M. K. (2003). Delineating mechanisms of change in child and adolescent therapy: Methodological issues and research recommendations. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *44*, 1116–1129. <http://doi.org/10.1111/1469-7610.00195>
- Kelly, A. C., & Carter, J. C. (2013). Why self-critical patients present with more severe eating disorder pathology: The mediating role of shame. *British Journal of Clinical Psychology*, *52*(2), 148–161. <http://doi.org/10.1111/bjc.12006>
- Kelly, A. C., & Carter, J. C. (2014). Self-compassion training for binge eating disorder: A pilot randomized controlled trial. *Psychology and Psychotherapy*, *1*, 146–156. <http://doi.org/10.1111/papt.12044>
- Kelly, A. C., Carter, J. C., & Borairi, S. (2014). Are improvements in shame and self-compassion early in eating disorders treatment associated with better patient outcomes? *International Journal of Eating Disorders*, *47*(1), 54–64. <http://doi.org/10.1002/eat.22196>
- Khoury, B., Knäuper, B., Schlosser, M., Carrière, K., & Chiesa, A. (2017). Effectiveness of traditional meditation retreats : A systematic review and meta-analysis. *Journal of Psychosomatic Research*, *92*, 16–25. <http://doi.org/10.1016/j.jpsychores.2016.11.006>
- Khoury, B., Lecomte, T., Gaudiano, B. A., & Paquin, K. (2013). Mindfulness interventions for psychosis : A meta-analysis. *Schizophrenia Research*, *150*(1), 176–184. <http://doi.org/10.1016/j.schres.2013.07.055>
- Khoury, B., Sharma, M., Rush, S. E., & Fournier, C. (2015). Mindfulness-based stress reduction for healthy individuals: A meta-analysis. *Journal of Psychosomatic Research*, *78*(6), 519–528. <http://doi.org/10.1016/j.jpsychores.2015.03.009>
- Kisbu-Sakarya, Y., MacKinnon, D. P., & Aiken, L. S. (2015). A Monte Carlo Comparison Study of the Power of the Analysis of Covariance, Simple Difference, and Residual Change Scores in Testing Two-Wave Data. *Educational and Psychological Measurement*, *73*(1), 47–62. <http://doi.org/doi:10.1177/0013164412450574>.
- Kraemer, H. C., Wilson, G. T., Fairburn, C. G., & Agras, W. S. (2002). Mediators and moderators of treatment effects in randomized clinical trials. *Archives of General Psychiatry*, *59*(10), 877–883. <http://doi.org/10.1001/archpsyc.59.10.877>
- Krahn, D. D., Kurth, C. L., Gomberg, E., & Drenowski, A. (2005). Pathological dieting and alcohol use in college women - A continuum of behaviors. *Eating Behaviors*, *6*(1), 43–52. <http://doi.org/10.1016/j.eatbeh.2004.08.004>
- Kristeller, J. L., & Wolever, R. Q. (2010). Mindfulness-Based Eating Awareness Training for Treating Binge Eating Disorder: The Conceptual Foundation. *Eating Disorders*, *19*(1), 49–61. <http://doi.org/10.1080/10640266.2011.533605>
- Kristeller, J., Wolever, R. Q., & Sheets, V. (2014). Mindfulness-Based Eating Awareness Training (MB-EAT) for Binge Eating: A Randomized Clinical Trial. *Mindfulness*, *5*(3), 282–297. <http://doi.org/10.1007/s12671-012-0179-1>
- Kuyken, W., Watkins, E., Holden, E., White, K., Taylor, R. S., Byford, S., ... Dalglish, T. (2010). How does mindfulness-based cognitive therapy work? *Behaviour Research and Therapy*, *48*(11), 1105–1112. <http://doi.org/10.1016/j.brat.2010.08.003>
- La Mela, C., Maglietta, M., Lucarelli, S., Mori, S., & Sassaroli, S. (2013). Pretreatment outcome indicators in an eating disorder outpatient group: The effects of self-esteem, personality disorders and dissociation. *Comprehensive Psychiatry*, *54*(7), 933–942. <http://doi.org/10.1016/j.comppsy.2013.03.024>
- Lakhan, S. E., & Schofield, K. L. (2013). Mindfulness-Based Therapies in the Treatment of Somatization Disorders: A Systematic Review and Meta-Analysis. *PLoS ONE*, *8*(8). <http://doi.org/10.1371/journal.pone.0071834>

- Latner, J. D., & Wilson, G. T. (2002). Self-monitoring and the assessment of binge eating. *Behavior Therapy, 33*(3), 465–477. [http://doi.org/10.1016/S0005-7894\(02\)80039-9](http://doi.org/10.1016/S0005-7894(02)80039-9)
- Laurenceau, J.-P., Hayes, A. M., & Feldman, G. C. (2007). Some methodological and statistical issues in the study of change processes in psychotherapy. *Clinical Psychology Review, 27*(6), 682–695. <http://doi.org/10.1016/j.cpr.2007.01.007>
- Lavender, J. M., Wonderlich, S. A., Engel, S. G., Gordon, K. H., Kaye, W. H., & Mitchell, J. E. (2015). Dimensions of emotion dysregulation in anorexia nervosa and bulimia nervosa: A conceptual review of the empirical literature. *Clinical Psychology Review, 40*, 111–122. <http://doi.org/10.1016/j.cpr.2015.05.010>
- Le Grange, D., Accurso, E. C., Lock, J., Agras, S., & Bryson, S. W. (2014). Early weight gain predicts outcome in two treatments for adolescent anorexia nervosa. *International Journal of Eating Disorders, 47*(2), 124–129. <http://doi.org/10.1002/eat.22221>
- Le Grange, D., Crosby, R. D., & Lock, J. (2008). Predictors and moderators of outcome in family-based treatment for adolescent bulimia nervosa. *Journal of the American Academy of Child and Adolescent Psychiatry, 47*(4), 464–470. <http://doi.org/10.1097/CHI.0b013e3181640816>
- Le Grange, D., Fitzsimmons-Craft, E. E., Crosby, R. D., Hay, P., Lacey, H., Bamford, B., ... Touyz, S. (2014). Predictors and moderators of outcome for severe and enduring anorexia nervosa. *Behaviour Research and Therapy, 56*, 91–98. <http://doi.org/10.1016/j.brat.2014.03.006>
- Le Grange, D., Lock, J., Agras, W. S., Moye, A., Bryson, S. W., Jo, B., & Kraemer, H. C. (2012). Moderators and mediators of remission in family-based treatment and adolescent focused therapy for anorexia nervosa. *Behaviour Research and Therapy, 50*(2), 85–92. <http://doi.org/10.1016/j.brat.2011.11.003>
- Linehan, M. M. (1993). *Cognitive-Behavioral Treatment of Borderline Personality Disorder*. New York: Guilford Press.
- Loeb, K. L., Lock, J., Greif, R., & le Grange, D. (2012). Transdiagnostic Theory and Application of Family-Based Treatment for Youth With Eating Disorders. *Cognitive and Behavioral Practice, 19*(1), 17–30.
- Loucas, C. E., Fairburn, C. G., Whittington, C., Pennant, M. E., Stockton, S., & Kendall, T. (2014). E-therapy in the treatment and prevention of eating disorders: A systematic review and meta-analysis. *Behaviour Research and Therapy, 63C*(2014), 122–131. <http://doi.org/10.1016/j.brat.2014.09.011>
- Mani, M., Kavanagh, D. J., Hides, L., & Stoyanov, S. R. (2015). Review and Evaluation of Mindfulness-Based iPhone Apps. *JMIR mHealth and uHealth, 3*(3), e82. <http://doi.org/10.2196/mhealth.4328>
- Martinez, M. A., & Craighead, L. W. (2015). Toward Person(ality)-Centered Treatment : How Consideration of Personality and Individual Differences in Anorexia Nervosa May Improve Treatment Outcome. *Clinical Psychology: Science and Practice, 22*(3), 296–314.
- Marx, L. S. (2016). A mindful eating "app" for non-treatment-seeking university women with eating and weight concerns (Doctoral dissertation).
- Mathieu, J. (2009). What Should You Know about Mindful and Intuitive Eating? *Journal of the American Dietetic Association, 109*(12), 1982–1987. <http://doi.org/10.1016/j.jada.2009.10.023>
- Munsch, S., Meyer, A. H., & Biedert, E. (2012). Efficacy and predictors of long-term treatment success for Cognitive-Behavioral Treatment and Behavioral Weight-Loss-Treatment in overweight individuals with binge eating disorder. *Behaviour Research and Therapy, 50*(12), 775–785. <http://doi.org/10.1016/j.brat.2012.08.009>

- Murphy, R., Cooper, Z., Hollon, S. D., & Fairburn, C. G. (2009). How do psychological treatments work? Investigating mediators of change. *Behaviour Research and Therapy*, 47(1), 1–5. <http://doi.org/10.1016/j.brat.2008.10.001>
- Murphy, R., Straebl, S., Basden, S., Cooper, Z., & Fairburn, C. G. (2012). Interpersonal Psychotherapy for Eating Disorders. *Interpersonal Psychotherapy for Eating Disorders*, 19(2), 150–158.
- Murphy, R., Straebl, S., Cooper, Z., & Fairburn, C. G. (2010). Cognitive Behavioral Therapy for Eating Disorders. *Psychiatric Clinics of North America*, 33(3), 611–627. <http://doi.org/10.1016/j.psc.2010.04.004>
- Mussell, M. P., Crosby, R. D., Crow, S. J., Knopke, A. J., Peterson, C. B., Wonderlich, S. A., & Mitchell, J. E. (2000). Utilization of empirically supported psychotherapy treatments for individuals with eating disorders: A survey of psychologists. *International Journal of Eating Disorders*, 27(2), 230–237. [http://doi.org/10.1002/\(SICI\)1098-108X\(200003\)27:2<230::AID-EAT11>3.0.CO;2-0](http://doi.org/10.1002/(SICI)1098-108X(200003)27:2<230::AID-EAT11>3.0.CO;2-0)
- National Institute for Clinical Excellence. (2004). *Eating disorders: Core interventions in the treatment and management of anorexia nervosa, bulimia nervosa and related eating disorders*.
- Neff, K. D. (2003a). Self-Compassion: An Alternative Conceptualization of a Healthy Attitude Toward Oneself. *Self and Identity*, 2(August 2002), 85–101. <http://doi.org/10.1080/15298860390129863>
- Neff, K. D. (2003b). The development and validation of a scale to measure self-compassion. *Self and Identity*, 2(February), 223–250. <http://doi.org/10.1080/15298860390209035>
- Neumark-Sztainer, D., Wall, M., Guo, J., Story, M., Haines, J., & Eisenberg, M. (2006). Obesity, Disordered Eating, and Eating Disorders in a Longitudinal Study of Adolescents: How Do Dieters Fare 5 Years Later? *Journal of the American Dietetic Association*, 106(4), 559–568.
- Neumark-Sztainer, D., Wall, M., Larson, N. I., Eisenberg, M. E., & Loth, K. (2011). Dieting and Disordered Eating Behaviors from Adolescence to Young Adulthood: Findings from a 10-Year Longitudinal Study. *Journal of the American Dietetic Association*, 111(7), 1004–1011. <http://doi.org/10.1016/j.jada.2011.04.012>
- Neumark-Sztainer, D., Wall, M., Story, M., & Standish, A. R. (2012). Dieting and Unhealthy Weight Control Behaviors During Adolescence: Associations With 10-Year Changes in Body Mass Index. *Journal of Adolescent Health*, 50(1), 80–86. <http://doi.org/10.1016/j.jadohealth.2011.05.010>
- Noordenbos, G., Aliakbari, N., & Campbell, R. (2014). The relationship among critical inner voices, low self-esteem, and self-criticism in eating disorders. *Eating Disorders*, 22(4), 337–51. <http://doi.org/10.1080/10640266.2014.898983>
- O’Reilly, G. A., Cook, L., Spruijt-Metz, D., & Black, D. S. (2014). Mindfulness-based interventions for obesity-related eating behaviours: a literature review. *Obesity Reviews : An Official Journal of the International Association for the Study of Obesity*, 15(6), 453–61. <http://doi.org/10.1111/obr.12156>
- Olmsted, M. P., MacDonald, D. E., McFarlane, T., Trottier, K., & Colton, P. (2015). Predictors of rapid relapse in bulimia nervosa. *The International Journal of Eating Disorders*, 48(3), 337–40. <http://doi.org/10.1002/eat.22380>
- Olson, K. L., & Emery, C. F. (2015). Mindfulness and Weight Loss: A Systematic Review. *Psychosomatic Medicine*, 77(1), 59–67. <http://doi.org/10.1097/PSY.0000000000000127>
- Perkins, S. S. J., Murphy, R. R., Schmidt, U. U., & Williams, C. (2006). Self-help and guided self-help for eating disorders. *Cochrane Database of Systematic Reviews*, (3). <http://doi.org/10.1002/14651858.CD004191.pub2>

- Plaza, I., Demarzo, M. M. P., Herrera-Mercadal, P., & García-Campayo, J. (2013). Mindfulness-based mobile applications: Literature review and analysis of current features. *Journal of Medical Internet Research, 15*(11), 1–19. <http://doi.org/10.2196/mhealth.2733>
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers, 36*(4), 717–731. <http://doi.org/10.3758/BF03206553>
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879–891. <http://doi.org/10.3758/BRM.40.3.879>
- Prochaska, J. J., Velicer, W. F., Nigg, C. R., & Prochaska, J. O. (2008). Methods of quantifying change in multiple risk factor interventions. *Preventive Medicine, 46*(3), 260–265. <http://doi.org/10.1016/j.ypmed.2007.07.035>
- Rome, E. S., & Ammerman, S. (2003). Medical complications of eating disorders: an update. *J Adolesc Health, 33*(6), 418–426.
- Safer, D. L., Telch, C. F., & Agras, W. S. (2001). Dialectical behavior therapy for bulimia nervosa. *American Journal of Psychiatry, 158*(4), 632–634.
- Schork, E. J., Eckert, E. D., & Halmi, K. A. (1994). The relationship between psychopathology, eating disorder diagnosis, and clinical outcome at 10-year follow-up in anorexia nervosa• 1. *Comprehensive Psychiatry, 35*(2), 113–123.
- Schwitzer, A. M. (2012). Diagnosing, conceptualizing, and treating eating disorders not otherwise specified: A comprehensive practice model. *Journal of Counseling and Development, 90*(3), 281–289. <http://doi.org/10.1002/j.1556-6676.2012.00036.x>
- Schwitzer, A. M., Rodriguez, L. E., Thomas, C., & Salimi, L. (2001). The Eating Disorders NOS Diagnostic Profile Among College Women. *Journal of American College Health, 49*(4), 157–166. <http://doi.org/10.1080/07448480109596298>
- Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse*. London, UK: Guilford Press.
- Seidel, A., Presnell, K., & Rosenfield, D. (2009). Mediators in the dissonance eating disorder prevention program. *Behaviour Research and Therapy, 47*(8), 645–653. <http://doi.org/10.1016/j.brat.2009.04.007>
- Shafran, R., Clark, D. M., Fairburn, C. G., Arntz, A., Barlow, D. H., Ehlers, A., ... Wilson, G. T. (2009). Mind the gap: Improving the dissemination of CBT. *Behaviour Research and Therapy, 47*(11), 902–909. <http://doi.org/10.1016/j.brat.2009.07.003>
- Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of Mindfulness. *Journal of Clinical Psychology, 62*(6), 373–386. <http://doi.org/10.1002/jclp>
- Smink, F. R. E., van Hoeken, D., Oldehinkel, A. J., & Hoek, H. W. (2014). Prevalence and severity of DSM-5 eating disorders in a community cohort of adolescents. *International Journal of Eating Disorders, 47*(6), 610–619. <http://doi.org/10.1002/eat.22316>
- Spijkerman, M. P. J., Pots, W. T. M., & Bohlmeijer, E. T. (2016). Effectiveness of online mindfulness-based interventions in improving mental health: A review and meta-analysis of randomised controlled trials. *Clinical Psychology Review, 45*, 102–114. <http://doi.org/10.1016/j.cpr.2016.03.009>
- Stice, E. (1998). Prospective relation of dieting behaviors to weight change in a community sample of adolescents. *Behavior Therapy, 29*(2), 277–297. [http://doi.org/10.1016/S0005-7894\(98\)80007-5](http://doi.org/10.1016/S0005-7894(98)80007-5)
- Stice, E., Marti, C. N., & Rohde, P. (2013). Prevalence, Incidence, Impairment, and Course of the Proposed DSM-5 Eating Disorders Diagnoses in an 8-year Prospective Community Study of Young Women. *Journal of Abnormal Psychology, 122*(2), 445–457.

- <http://doi.org/10.1016/j.micinf.2011.07.011>. Innote
- Stice, E., Presnell, K., Gau, J., & Shaw, H. (2007). Testing Mediators of Intervention Effects in Randomized Controlled Trials: An Evaluation of Two Eating Disorder Prevention Programs. *J Consult Clin Psychol*, *75*(1), 20–32. <http://doi.org/10.1037/0022-006X.75.1.20>
- Stice, E., Presnell, K., Gau, J., & Shaw, H. (2009). Testing Mediators of Intervention Effects in Randomized Controlled Trials: An Evaluation of Two Eating Disorder Prevention Programs. *Journal of Consulting and Clinical Psychology*, *75*(1), 20–32. <http://doi.org/10.1037/0022-006X.75.1.20>. Testing
- Stice, E., Rohde, P., Seeley, J. R., & Gau, J. M. (2010). Testing mediators of intervention effects in randomized controlled trials: An evaluation of three depression prevention programs. *Journal of Consulting and Clinical Psychology*, *78*(2), 273–280. <http://doi.org/10.1037/a0018396>
- Svaldi, J., Gripenstroh, J., Tuschen-Caffier, B., & Ehring, T. (2012). Emotion regulation deficits in eating disorders: A marker of eating pathology or general psychopathology? *Psychiatry Research*, *197*(1–2), 103–111.
- Tchanturia, K., Doris, E., & Fleming, C. (2014). Effectiveness of Cognitive Remediation and Emotion Skills Training (CREST) for Anorexia Nervosa in Group Format: A Naturalistic Pilot Study. *European Eating Disorders Review*, *22*(3), 200–205. <http://doi.org/10.1002/erv.2287>
- Tchanturia, K., Lounes, N., & Holtum, S. (2014). Cognitive remediation in anorexia nervosa and related conditions: a systematic review. *European Eating Disorders Review: The Journal of the Eating Disorders Association*, *22*(6), 454–62. <http://doi.org/10.1002/erv.2326>
- Telch, C. F., Agras, W. S., & Linehan, M. M. (2001). Dialectical behavior therapy for binge eating disorder. *J Consult Clin Psychol*, *69*(6), 1061.
- Thompson-Brenner, H., Franko, D. L., Thompson, D. R., Grilo, C. M., Boisseau, C. L., Roehrig, J. P., ... Masheb, R. (2013). Race/Ethnicity, Education, and Treatment Parameters as Moderators and Predictors of Outcome in Binge Eating Disorder. *Journal of Consulting and Clinical Psychology*, *81*(4), 710–721. <http://doi.org/10.1016/j.micinf.2011.07.011>. Innote
- Traviss-Turner, G. D., West, R. M., & Hill, A. J. (2017). Guided Self-help for Eating Disorders: A Systematic Review and Metaregression. *European Eating Disorders Review*, *25*(3), 148–164. <http://doi.org/10.1002/erv.2507>
- Traviss, G. D., Heywood-Everett, S., & Hill, A. J. (2013). Understanding the “guide” in guided self-help for disordered eating: A qualitative process study. *Psychology and Psychotherapy: Theory, Research and Practice*, *86*(1), 86–104. <http://doi.org/10.1111/j.2044-8341.2011.02049.x>
- Treasure, J., & Russell, G. (2011). The case for early intervention in anorexia nervosa: Theoretical exploration of maintaining factors. *British Journal of Psychiatry*, *199*(1), 5–7. <http://doi.org/10.1192/bjp.bp.110.087585>
- Turner, H., Marshall, E., Wood, F., Stopa, L., & Waller, G. (2016). CBT for eating disorders: The impact of early changes in eating pathology on later changes in personality pathology, anxiety and depression. *Behaviour Research and Therapy*, *77*, 1–6. <http://doi.org/10.1016/j.brat.2015.11.011>
- Turner, H., Tatham, M., Lant, M., Mountford, V. a., & Waller, G. (2014). Clinicians’ concerns about delivering cognitive-behavioural therapy for eating disorders. *Behaviour Research and Therapy*, *57*(October 2015), 38–42. <http://doi.org/10.1016/j.brat.2014.04.003>
- Valente, M. J., & MacKinnon, D. P. (2017). Comparing Models of Change to Estimate the Mediated Effect in the Pretest–Posttest Control Group Design. *Structural Equation Modeling: A Multidisciplinary Journal*, *24*(3), 1–23.

- <http://doi.org/10.1080/10705511.2016.1274657>
- Vall, E., & Wade, T. D. (2015). Predictors of treatment outcome in individuals with eating disorders: A systematic review and meta-analysis. *International Journal of Eating Disorders*, (July), n/a-n/a. <http://doi.org/10.1002/eat.22411>
- Vøllestad, J., Nielsen, M. B., & Nielsen, G. H. (2012). Mindfulness- and acceptance-based interventions for anxiety disorders : A systematic review and meta-analysis. *British Journal of Clinical Psychology*, 51(3), 239–260. <http://doi.org/10.1111/j.2044-8260.2011.02024.x>
- Von Ranson, K. M., & Robinson, K. E. (2006). Who is providing what type of psychotherapy to eating disorder clients? A survey. *International Journal of Eating Disorders*, 39(1), 27–34. <http://doi.org/10.1002/eat.20201>
- Von Ranson, K. M., Wallace, L. M., & Stevenson, A. (2013). Psychotherapies provided for eating disorders by community clinicians: Infrequent use of evidence-based treatment. *Psychotherapy Research*, 23(3), 333–343. <http://doi.org/10.1080/10503307.2012.735377>
- Wagner, G., Penelo, E., Nobis, G., Mayrhofer, A., Wanner, C., Schau, J., ... Karwautz, A. (2015). Predictors for Good Therapeutic Outcome and Drop-out in Technology Assisted Guided Self-Help in the Treatment of Bulimia Nervosa and Bulimia like Phenotype. *European Eating Disorders Review*, 23(2), 163–169. <http://doi.org/10.1002/erv.2336>
- Wallace, L. M., & von Ranson, K. M. (2012). Perceptions and use of empirically-supported psychotherapies among eating disorder professionals. *Behaviour Research and Therapy*, 50(3), 215–22. <http://doi.org/10.1016/j.brat.2011.12.006>
- Waller, G. (2009). Evidence-based treatment and therapist drift. *Behaviour Research and Therapy*, 47(2), 119–127. <http://doi.org/10.1016/j.brat.2008.10.018>
- Waller, G. (2012). The myths of motivation: Time for a fresh look at some received wisdom in the eating disorders? *International Journal of Eating Disorders*, 45(1), 1–16. <http://doi.org/10.1002/eat.20900>
- Waller, G., Mountford, V. A., Tatham, M., Turner, H., Gabriel, C., & Webber, R. (2013). Attitudes towards psychotherapy manuals among clinicians treating eating disorders. *Behaviour Research and Therapy*, 51(12), 840–844. <http://doi.org/10.1016/j.brat.2013.10.004>
- Waller, G., Stringer, H., & Meyer, C. (2012). What cognitive behavioral techniques do therapists report using when delivering cognitive behavioral therapy for the eating disorders? *Journal of Consulting and Clinical Psychology*, 80(1), 171–175. <http://doi.org/10.1037/a0026559>
- Wildes, J. E., & Marcus, M. D. (2011). Development of emotion acceptance behavior therapy for anorexia nervosa: A case series. *International Journal of Eating Disorders*, 44(5), 421–427. <http://doi.org/10.1002/eat.20826>
- Wilfley, D. E., Agras, W. S., & Taylor, C. B. (2013). Reducing the Burden of Eating Disorders: A Model for Population-Based Prevention and Treatment for University and College Campuses. *International Journal of Eating Disorders*, 46(5), 529–532. <http://doi.org/10.1038/jid.2014.371>
- Wilfley, D. E., Friedman, M. A., Douchis, J. Z., Stein, R. I., Welch, R. R., & Ball, S. A. (2000). Comorbid psychopathology in binge eating disorder: relation to eating disorder severity at baseline and following treatment. *Journal of Consulting and Clinical Psychology*, 68(4), 641–649. <http://doi.org/10.1037/0022-006X.68.4.641>
- Wilson, G. T., Fairburn, C. C., Agras, W. S., Walsh, B. T., & Kraemer, H. (2002). Cognitive-behavioral therapy for bulimia nervosa: time course and mechanisms of change. *Journal of Consulting and Clinical Psychology*, 70(2), 267–274. <http://doi.org/10.1037/0022-006X.70.2.267>
- Wilson, G. T., Loeb, K. L., Walsh, B. T., Labouvie, E., Petkova, E., Liu, X., & Waternaux, C.

- (1999). Psychological versus pharmacological treatments of bulimia nervosa: predictors and processes of change. *Journal of Consulting and Clinical Psychology, 67*(4), 451–459. <http://doi.org/10.1037/0022-006X.67.4.451>
- Wilson, G. T., & Zandberg, L. J. (2012). Cognitive–behavioral guided self-help for eating disorders: Effectiveness and scalability. *Clin Psychol Rev, 32*(4), 343–357. <http://doi.org/10.1016/j.cpr.2012.03.001>
- Wonderlich, S. A., Peterson, C. B., Crosby, R. D., Smith, T. L., Klein, M. H., Mitchell, J. E., & Crow, S. J. (2014). A randomized controlled comparison of integrative cognitive-affective therapy (ICAT) and enhanced cognitive-behavioral therapy (CBT-E) for bulimia nervosa. *Psychological Medicine, 44*(3), 543–553. <http://doi.org/10.1017/S0033291713001098>
- Zaitsoff, S., Pullmer, R., Cyr, M., & Aime, H. (2015). The Role of the Therapeutic Alliance in Eating Disorder Treatment Outcomes: A Systematic Review. *Eating Disorders, 23*(2), 99–114.

Table 1. Sample Demographics.

	Mean \pm Std. Dev.
Age (n=188)	22.39 \pm 3.20 (range: 18.16-30.98)
BMI (n=187)	24.65 \pm 5.12 (range: 16.00-48.65)
	n (%)
Ethnicity (n=189)	
Hispanic/Latino	12 (6.3%)
Not Hispanic/Latino	177 (93.7%)
Race (n=189)	
Asian	43 (22.8%)
Black	21 (11.1%)
White	112 (59.3%)
Mixed or other	13 (6.9%)
English as first language (n=189)	
Yes	158 (83.6%)
No	31 (16.4%)
Past ED diagnosis (n=188)	
Yes	7 (3.7%)
No	181 (96.3%)
Past ED treatment (n=189)	
Yes	10 (5.3%)
No	179 (94.7%)
Past mindfulness/meditation experience (n=189)	
Yes	82 (43.6%)
No	107 (56.4%)
Past eating self-monitoring (n=189)	
Yes	147 (77.8%)
No	41 (21.8%)

Table 2. Component loadings.

	Visit 1 (n=188)	Visit 2 (n=181)	Follow-Up (n=154)
BES	.809	.818	.813
DIS	.677	.732	.634
MAC-R	.878	.868	.797
PEWS	.864	.825	.807

DIS=Dietary Intent Scale; BES=Binge Eating Scale; MAC-R=Mizes Anorectic Cognitions – Revised; PEWS=Preoccupation with Eating and Weight Scale

Table 3. Correlation between variables at baseline.

	BES total score	DIS total score	MAC-R total score	PEWS preoccupation total score	Total app entries	MES total score	SCS total score	DERS total score	FFMQ total score
DIS total score	.330** n=188								
MAC-R total score	.609** n=188	.528** n=188							
PEWS preoccupation total score	.649** n=188	.433** n=188	.433** n=188						
Total app entries	.192* n=159	.054 n=159	.054 n=159	.160* n=159					
MES total score	-.580** n=188	-.281** n=188	-.502** n=188	-.576** n=188	-.191* n=159				
SCS total score	-.354** n=188	-.084 n=188	-.470** n=188	-.337** n=188	.011 n=159	.298** n=188			
DERS total score	.402** n=188	.119 n=188	.462** n=188	.362** n=188	.025 n=159	-.315** n=188	-.668** n=188		
FFMQ total score	-.341** n=188	-.118 n=188	-.366** n=188	-.251** n=188	-.008 n=159	.368** n=188	.624 n=188	-.586** n=188	
BMI	.233** n=186	.246** n=186	.201 n=186	.152* n=186	-.033 n=157	-.038 n=186	-.006 n=186	.040 n=186	-.073 n=186

BES=Binge Eating Scale; DIS=Dietary intent Scale; MAC-R=Mizes Anorectic Cognitions – Revised; PEWS=Preoccupation with Eating and Weight Scale; MES=Mindful Eating Scale; SCS=Self-Compassion Scale; DERS=Difficulties with Emotion Regulation Scale; FFMQ=Five Factor Mindfulness Questionnaire; BMI=Body Mass Index

* Correlation is significant at $p < .05$

**Correlation is significant at $p < .01$

Table 4. Results of repeated measures ANOVAs for measures of eating pathology.

Measure	F	df	p	η^2_{partial}	η^2_{general}
Binge Eating Scale (BES; n=165)					
Time	36.672	1, 163	.000***	0.184	0.032
Group	0.661	1, 163	.417	0.004	0.004
Time*Group	0.005	1, 163	.945	0.000	0.000
Dietary Intent Scale (DIS; n=168)					
Time	5.019	1, 166	.026*	0.029	0.005
Group	0.001	1, 166	.969	0.000	0.000
Time*Group	4.740	1, 166	.031*	0.028	0.005
Mizes Anorectic Cognitions Scale (MAC; n=168)					
Time	14.412	1, 166	.000***	0.080	0.010
Group	0.019	1, 166	.890	0.000	0.000
Time*Group	0.063	1, 166	.802	0.000	0.000
Preoccupation with Eating and Weight Scale (PEWS; n=167)					
Time	47.978	1, 165	.000***	0.225	0.056
Group	0.437	1, 165	.510	0.003	0.002
Time*Group	1.093	1, 165	.297	0.007	0.001

Note: In accordance with the recommendations of Lakens (2013), both partial and generalized eta-squared (η^2_{partial} and η^2_{general}) are reported here, as η^2_{general} provides a measurement of effect size that is comparable across studies with different research designs by excluding variance from other factors (e.g., covariates) while retaining variance due to individual difference (see also Olejnik & Algina, 2003).

*p<.05

**p<.01

***p<.001

Table 5. Results of paired-samples t-tests for measures of eating pathology and proposed mediators.

Measure	Pre-Intervention Mean \pm Std. Dev.	Post-Intervention Mean \pm Std. Dev.	<i>t</i> (df)	<i>p</i>	Hedges' <i>g_{av}</i>	Common Language Effect
Measures of disordered eating						
BES total score						
Immediate group (n=88)	13.901 \pm 7.455	11.128 \pm 7.043	--	--	--	--
Delayed group (n=77)	14.762 \pm 7.913	12.052 \pm 8.082	--	--	--	--
Full sample (n=165)	14.303 \pm 7.661	11.559 \pm 7.536	6.092 (164)	.000***	0.360	0.682
DIS total score						
Immediate group (n=88)	21.171 \pm 5.917	19.421 \pm 5.396	3.462 (87)	.001**	--	--
Delayed group (n=80)	20.275 \pm 6.860	20.250 \pm 6.200	0.040 (79)	.968	--	--
Total sample (n=168)	20.744 \pm 6.380	19.916 \pm 5.790	2.321 (167)	.022**	0.152	0.571
MAC-R total score						
Immediate group (n=88)	67.466 \pm 13.103	64.593 \pm 12.902	--	--	--	--
Delayed group (n=80)	67.016 \pm 13.733	64.500 \pm 13.733	--	--	--	--
Full sample (n=168)	67.252 \pm 13.710	64.549 \pm 13.264	3.823 (167)	.000***	0.200	0.616
PEWS total preoccupation score						
Immediate group (n=88)	3.633 \pm 1.242	2.932 \pm 1.281	--	--	--	--
Delayed group (n=79)	3.426 \pm 1.335	2.909 \pm 1.147	--	--	--	--
Full sample (n=167)	3.535 \pm 1.287	2.921 \pm 1.216	6.991 (166)	.000***	0.489	0.706

p*<.01*p*<.001

Note: Hedges' *g_{av}* and the Common Language effect sizes are presented in accord with the recommendations of Lakens (2013).

Hedges' *g_{av}* offers a correction to Cohen's *d* by utilizing the average standard deviation between groups of observations, rather than the difference. The Common Language (CL) effect size expresses, in within-subjects designs, “the probability that an individual has a higher value on one measurement than the other” (Lakens, 2013, p. 4; see also McGraw & Wong, 1992) and can be interpreted as a percentage likelihood (i.e., for the BES total score, the CL effect size of .682 can be read as a 68.2% likelihood of a lower score at post-intervention as opposed to pre-intervention).

Table 5, continued.

Measure	Pre-Intervention Mean \pm Std. Dev.	Post-Intervention Mean \pm Std. Dev.	<i>t</i> (df)	<i>p</i>	Hedges' <i>g_{av}</i>	Common Language Effect
Measures of proposed intervention-specific mediators						
MES total score						
Immediate group (n=88)	75.307 \pm 9.422	81.523 \pm 9.422	--	--	--	--
Delayed group (n=80)	75.821 \pm 10.693	81.325 \pm 9.981	--	--	--	--
Full sample (n=168)	75.552 \pm 10.020	81.429 \pm 9.308	-8.894 (167)	.000***	0.607	0.754
SCS total score						
Immediate group (n=88)	2.973 \pm 0.732	3.152 \pm 0.722	--	--	--	--
Delayed group (n=80)	2.826 \pm 0.738	3.042 \pm 0.691	--	--	--	--
Full sample (n=168)	2.903 \pm 0.736	3.100 \pm 0.707	-5.496 (167)	.000***	0.272	0.664
Measures of proposed theoretically-relevant mediators						
DERS total score						
Immediate group (n=88)	96.875 \pm 17.056	94.169 \pm 16.961	--	--	--	--
Delayed group (n=80)	99.425 \pm 16.653	91.201 \pm 20.614	--	--	--	--
Full sample (n=168)	98.089 \pm 16.864	92.755 \pm 18.791	5.034 (167)	.000***	0.299	0.651
FFMQ total score						
Immediate group (n=88)	76.205 \pm 12.945	80.686 \pm 11.756	--	--	--	--
Delayed group (n=80)	73.361 \pm 11.822	79.733 \pm 11.158	--	--	--	--
Full sample (n=168)	74.850 \pm 12.468	80.232 \pm 11.451	-7.105 (167)	.000***	0.449	0.708

p*<.01*p*<.001

Note: Hedges' *g_{av}* and the Common Language effect sizes are presented in accord with the recommendations of Lakens (2013).

Hedges' *g_{av}* offers a correction to Cohen's *d* by utilizing the average standard deviation between groups of observations, rather than the difference. The Common Language (CL) effect size expresses, in within-subjects designs, “the probability that an individual has a higher value on one measurement than the other” (Lakens, 2013, p. 4; see also McGraw & Wong, 1992) and can be interpreted as a percentage likelihood (i.e., for the BES total score, the CL effect size of .682 can be read as a 68.2% likelihood of a lower score at post-intervention as opposed to pre-intervention).

Table 6. Summary of mediation analyses for aims 1 and 2.

Mediators	Predictor/Outcome		
	Binge Eating ^b	Preoccupation with eating/weight ^c	Dysfunctional cognitions ^d
Aim 1			
Frequency of Eating	$a_1=0.489^*$	$a_1b_1=0.031^*$	NS
Mindful Eating ^a	$b_2=-2.189^{**}$	$b_2=-0.327^{**}$	$b_2=-1.614^*$
Self-Compassion ^a	NS	NS	$b_3=-1.520^*$
Aim 2			
Emotion Regulation ^a	NS	NS	$b_1=2.552^{**}$
Trait Mindfulness ^a	NS	NS	NS

* $p < .05$ ** $p < .01$

NS= Not statistically significant

^a Denotes that the residualized change score was used^b Models 1.1 and 2.1^c Models 1.2 and 2.2^d Models 1.3 and 2.3

Figure 1. Consort diagram.

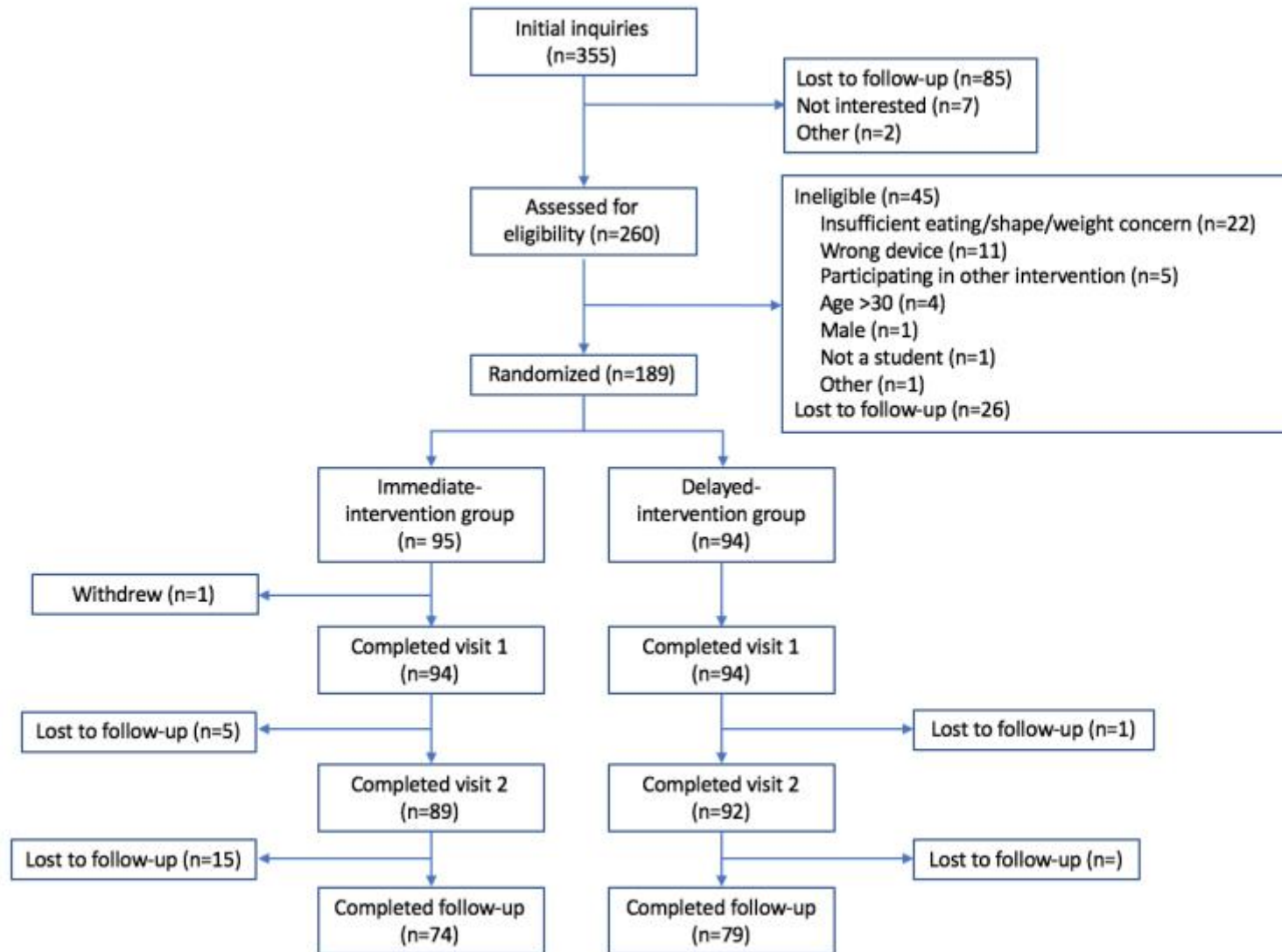
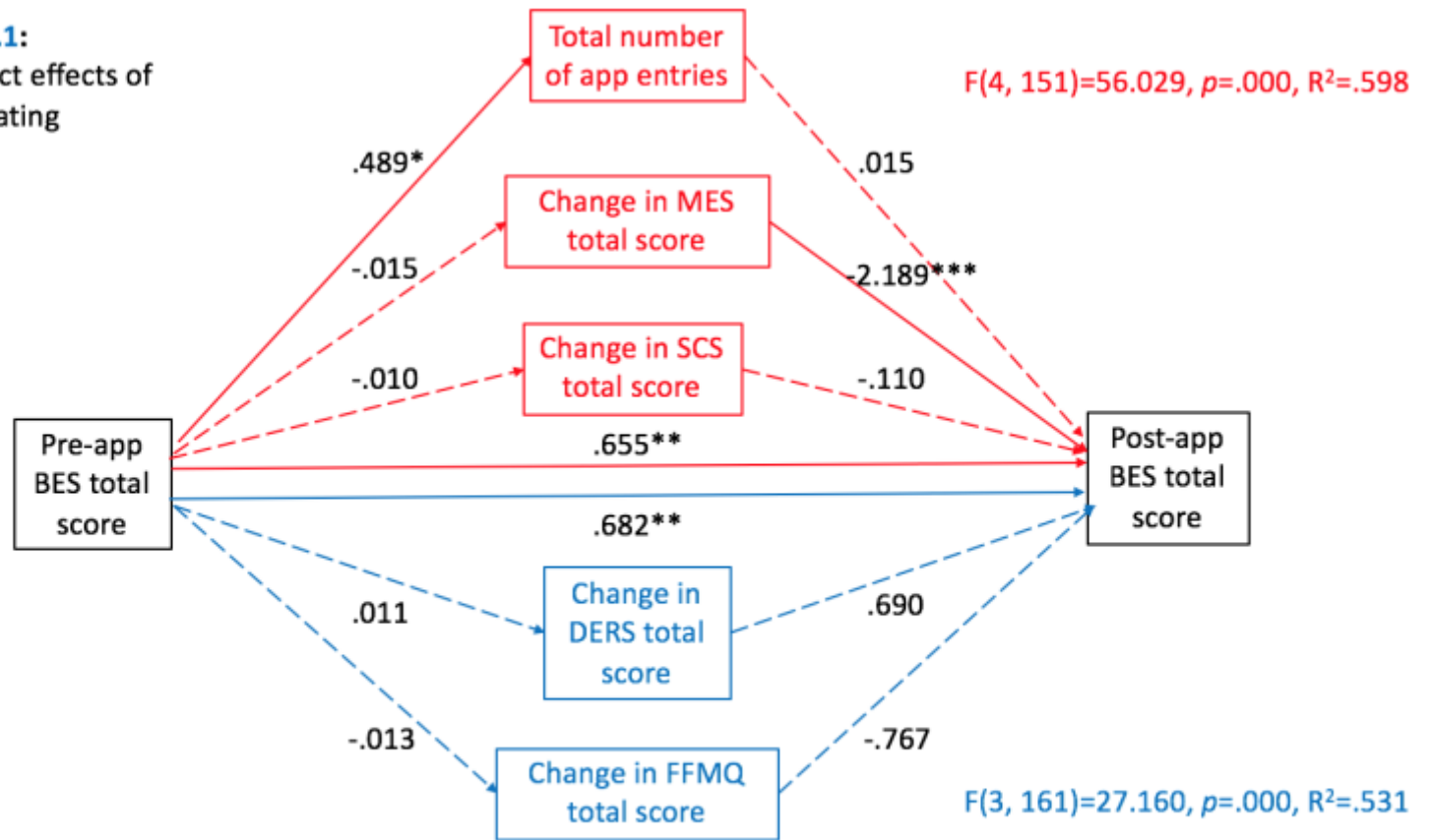


Figure 2. Results of mediation analyses examining change in binge eating through intervention-specific (Aim 1) and theoretically-relevant (Aim 2) mediators.

Models 1.1 and 2.1:

Conditional indirect effects of change in binge eating

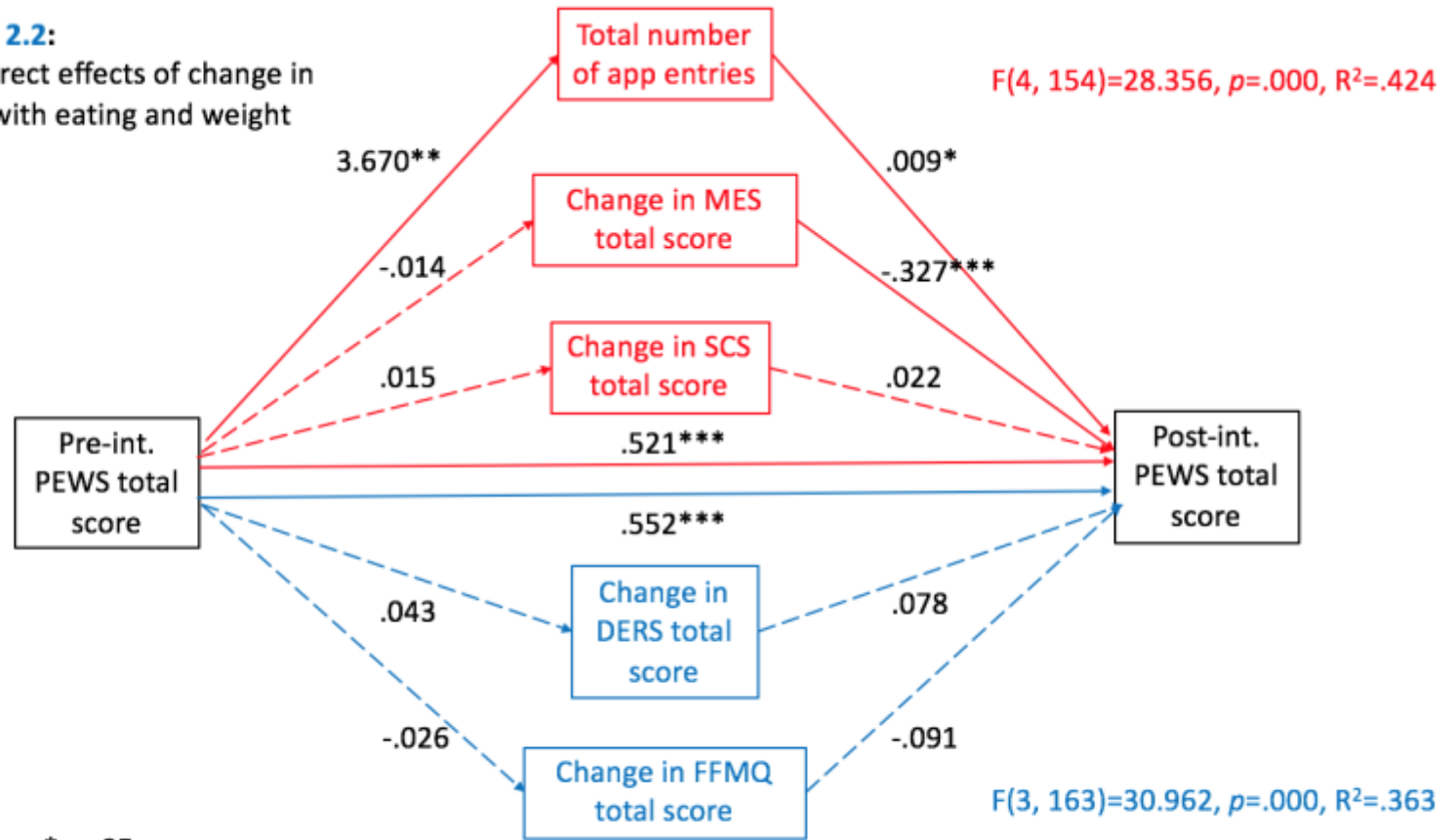


*p<.05
 **p<.01
 ***p<.001

Figure 3. Results of mediation analyses examining change in preoccupation with eating and weight through intervention-specific (Aim 1) and theoretically-relevant (Aim 2) mediators.

Models 1.2 and 2.2:

Conditional indirect effects of change in preoccupation with eating and weight

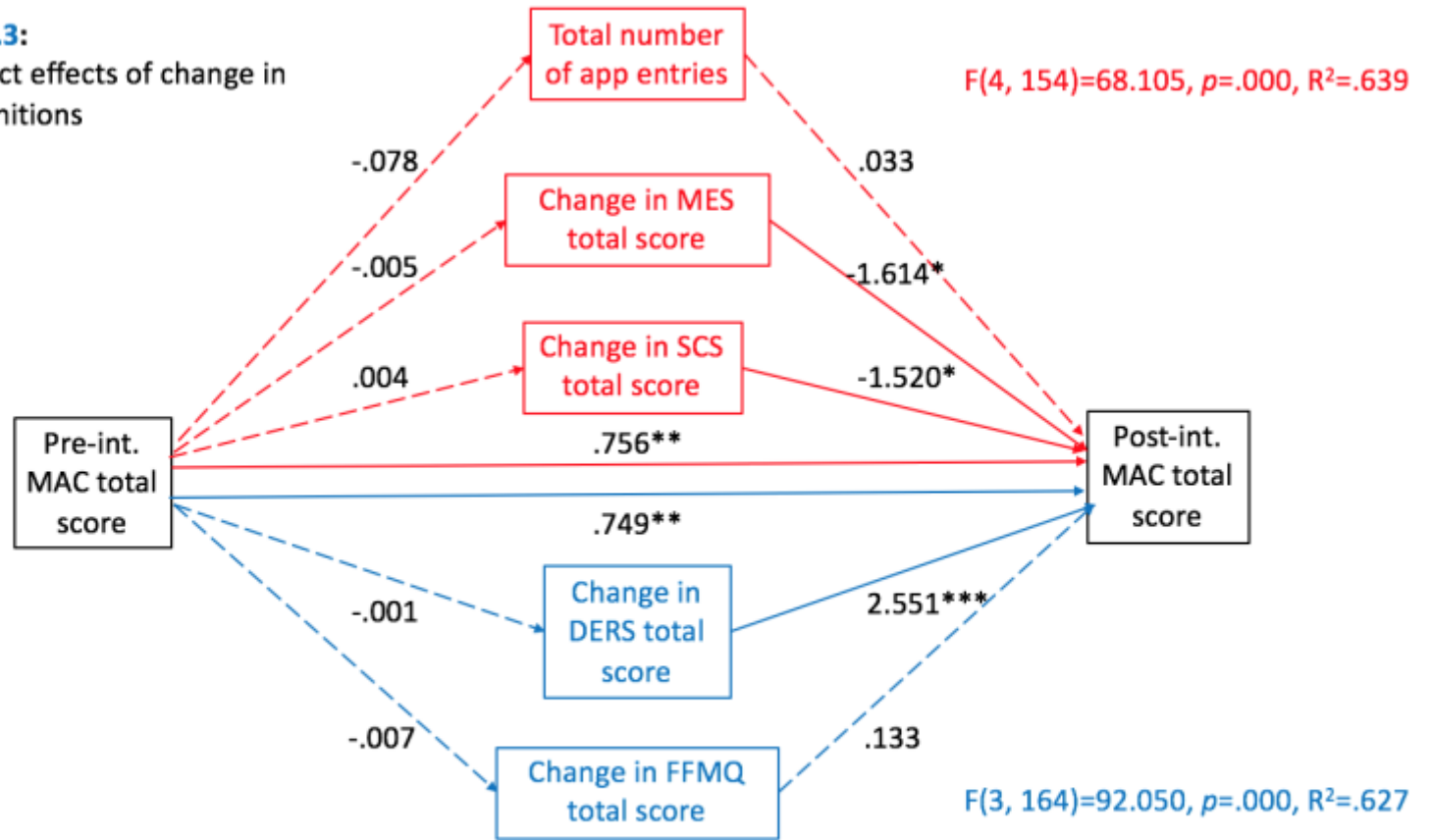


*p<.05
 **p<.01
 ***p<.001

Figure 4. Results of mediation analyses examining change in dysfunctional cognitions through intervention-specific (Aim 1) and theoretically-relevant (Aim 2) mediators.

Models 1.3 and 2.3:

Conditional indirect effects of change in dysfunctional cognitions

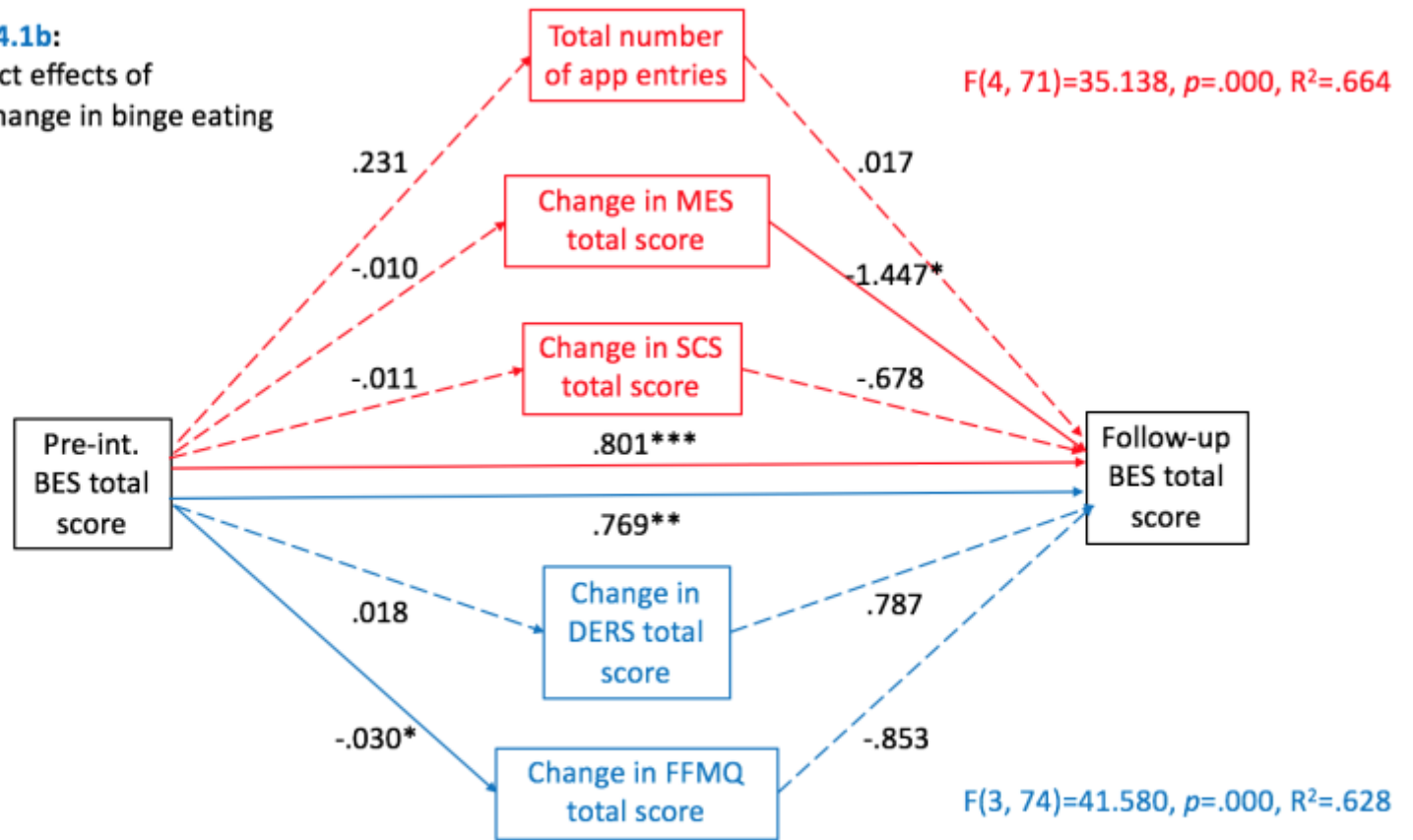


*p<.05
 **p<.01
 ***p<.001

Figure 5. Results of mediation analyses examining maintenance of change in binge eating through intervention-specific and theoretically-relevant mediators (Exploratory Aim 2).

Models 4.1a and 4.1b:

Conditional indirect effects of maintenance of change in binge eating

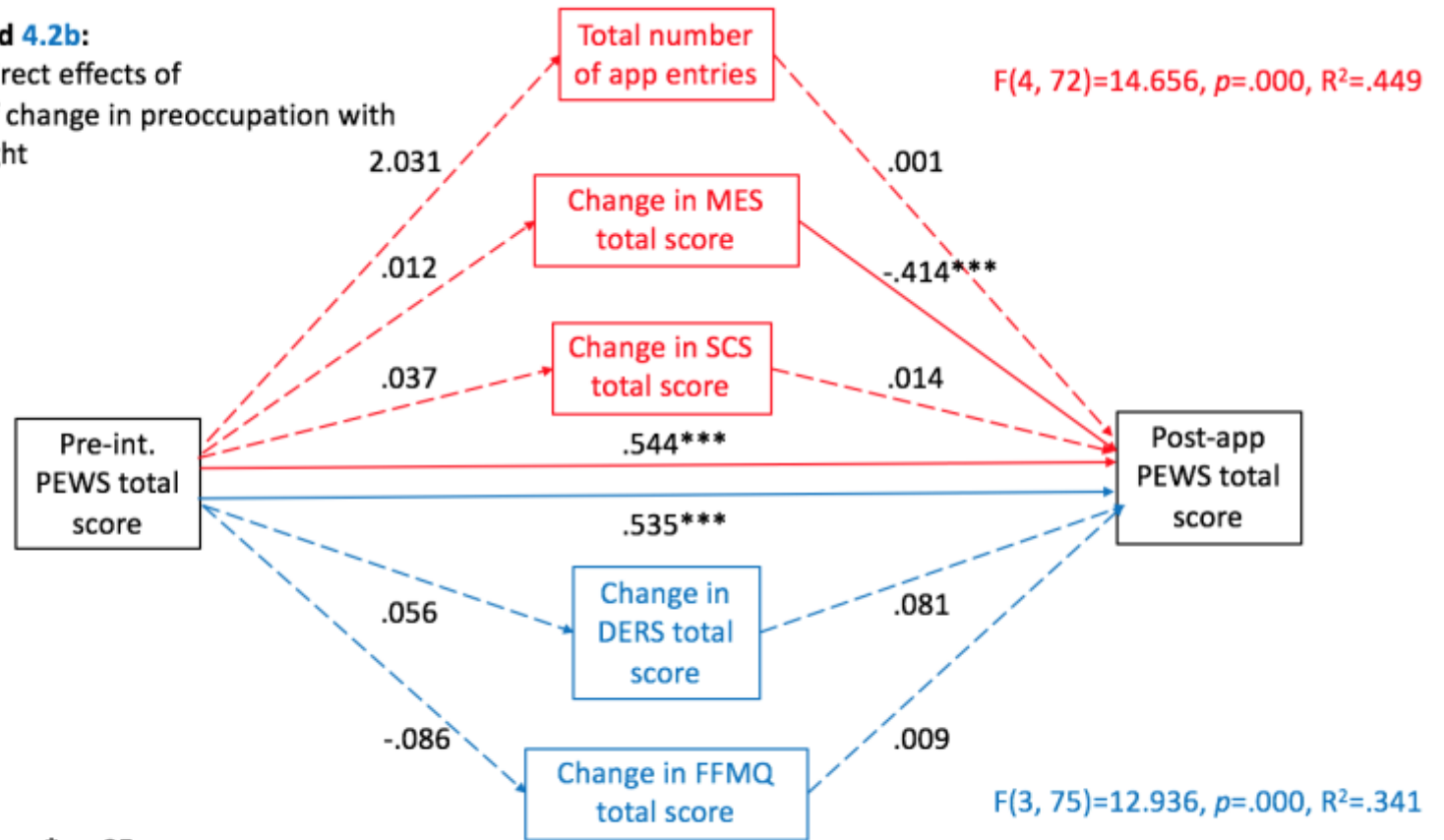


*p<.05
 **p<.01
 ***p<.001

Figure 6. Results of mediation analyses examining maintenance of change in preoccupation with eating and weight through intervention-specific and theoretically-relevant mediators (Exploratory Aim 2).

Models 4.2a and 4.2b:

Conditional indirect effects of maintenance of change in preoccupation with eating and weight

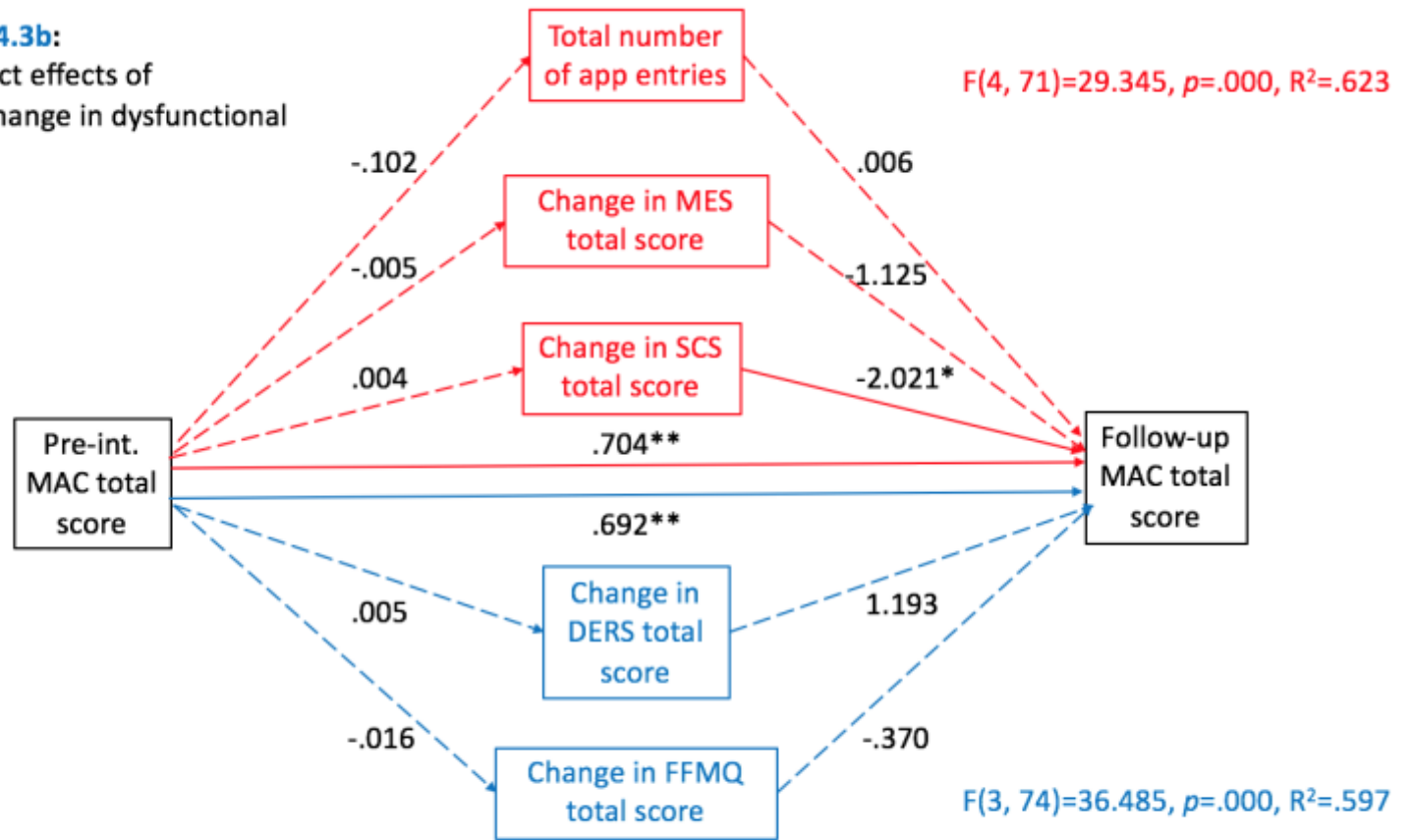


*p<.05
 **p<.01
 ***p<.001

Figure 7. Results of mediation analyses examining maintenance of change in dysfunctional cognitions through intervention-specific and theoretically-relevant mediators (Exploratory Aim 2).

Models 4.3a and 4.3b:

Conditional indirect effects of maintenance of change in dysfunctional cognitions



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