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The effects of an Internet-delivered mindfulness-based intervention on perceived stress, psychological symptoms, and emotion regulation

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By

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ABSTRACT

The aim of this dissertation was to assess the impacts of a novel Internet-delivered mindfulness-based intervention (ID-MBI) for emotional distress and emotion regulation in a university sample in three related studies. The first study assessed participants' engagement with the intervention by self-reported compliance and a novel computer-timed measure of compliance (i.e., time spent using guided mindfulness exercises). The second study examined the impact of personality factors and compliance on the effectiveness of the intervention. The third study assessed the impact of the intervention on emotion regulation, emotional distress, perceived stress, and mindfulness, and identified potential mechanisms of change. This study implemented a randomized waitlist control design, with participants assigned to either the four-week ID-MBI group or a four-week waitlist group (N = 84). Participants completed baseline and follow-up assessments in person. Results of the first study demonstrated an excellent degree of reliability between self-reported retrospective and daily report of time spent practicing mindfulness (ICC = .729, $F(36, 36) = 6.639$, $p < .001$) and a fair degree of reliability between the retrospective and the objective computer-timed compliance measure (ICC = .407, $F(36,36)= 2.49$, $p =.004$). A multiple regression analysis using group membership, personality factors, and preintervention mindfulness was conducted to assess the factors that predict postintervention mindfulness. The model was statistically significant, $F(4,66) = 25.587$, $p < .001$, with group membership ($B = -7.977$, $SE = 2.754$, $t = -2.897$, $p = .005$), neuroticism ($B = -0.604$, SE = .279, $t = -2.168$, $p = 0.034$), and preintervention mindfulness ($B = 0.505$, SE = .110, $t = 4.611$, $p <.001$) significantly predicting postintervention mindfulness. Finally, a series of 2 (group) x 2 (time) ANOVAs

demonstrated that compared to the waitlist group, the intervention group showed significant improvements on emotion regulation ($F(1, 36) = 29.082$, $p < .001$, partial $\eta^2 = .447$), reductions in perceived stress ($F(1, 36) = 6.805$, $p = .013$, partial $\eta^2 = .159$), and reductions in negative affect ($F(1, 36) = 10.748$, $p = .002$, partial $\eta^2 = .230$). Of note, both groups reported higher levels of mindfulness at postintervention; however, the effect size was larger for the mindfulness group ($F(1, 36) = 24.875$, $p < .001$, partial $\eta^2 = .409$). No changes were seen for emotional distress. Overall, the results of the study suggest that a brief Internet-delivered MBI may be effective in higher education settings for improving general well-being in students.

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LIST OF ABBREVIATIONS

ACT: Acceptance and commitment therapy

APA: American Psychological Association

CBT: Cognitive behavioural therapy

CPA: Canadian Psychological Association

ICC: Intraclass correlation coefficient

ID-MBI: Internet-delivered mindfulness-based interventions

MBCT: Mindfulness-based cognitive therapy

MBI: Mindfulness-based Intervention

MBSR: Mindfulness-based stress reduction

RCT: Randomized controlled trial

WCC: Waitlist control condition

CHAPTER 1

Literature Review

In 2013, 83% of Canadian households had access to the Internet (Statistics Canada, 2012). Furthermore, they spent roughly 45 hours per month online, which is twice the global average (CIRA, 2013), demonstrating that Internet usage has become highly integrated into Canadian society. It is used for a number of activities ranging from social media, shopping, and news and entertainment (CIRA, 2013), to accessing online mental health information, such as finding available services, psychoeducational resources, and even engaging in psychotherapeutic interventions (Barak, Klein, & Proudfoot, 2009).

Internet-Supported Therapeutic Interventions

As Internet use has become integrated into the daily lives of many Canadians, health care and mental health professionals have benefited from beginning to offer helping services with increased flexibility through the Internet. Although Internet-delivered interventions have been met with some opposition, the increased use of the Internet as a means of social engagement, the development of ethical guidelines by professional psychological organizations, including the Canadian and American Psychological Associations (CPA, APA), and the growing research support for their efficacy, has resulted in increasing acceptance and support (Barak et al., 2009). In 2010, a survey of U.S. adults indicated that 80% of those surveyed had looked online for health information (e.g., information about specific diseases/disorders, treatment information) and 25% reported watching online videos about health or medical treatments (Fox, 2011). Although there is no clear evidence to suggest how accurately individuals interpret health

information found online, research suggests that the Internet is not always an accurate or effective source for healthcare information (Bernstam, Shelton, Walji, & Meric-Bernstam, 2005), which may lead to concerns for offering mental health information and services online. However, a benefit of human-supported Internet-delivered interventions is that a mental health care worker is available to answer questions and help clarify information to facilitate accurate interpretation of information. The percentage of individuals using the Internet as a mode of psychological intervention delivery is more difficult to estimate. However, MoodGYM, an Internet-based self-directed intervention to teach cognitive-behavioural therapy (CBT) for depression, has over 1.2 million registered users worldwide ("Our packages", nd), suggesting increased interest and acceptance of Internet-delivered psychotherapeutic interventions.

There are numerous benefits of Internet-delivered interventions. Limited access to evidence-based treatment and low treatment rates continue to be a concern for mental health care providers. Many factors can contribute to low treatment rate, such as limited availability of treatment (Wang et al., 2007), fear of stigma (Gulliver, Griffiths, & Christensen, 2010), regional disparities (CMHA, 2012), and financial barriers (CMHA, 2012). Internet-delivered interventions provide greater flexibility in terms of time and location of service access, cost-efficient services (Hadjistavropoulos, Alberts, Nugent, & Marchildon, 2014; Hedman et al., 2011; Hedman et al., 2013), and increasing accessibility of services for individuals in rural areas or individuals of lower socioeconomic status who are unable to access services due to time or financial barriers (e.g., transportation, child care, inflexible work schedule). Internet-delivered interventions are not intended to replace traditional therapy, especially given that not all

individuals have access to the Internet; however, over the last 15 years, differences in Internet access has declined with regard to previous demographic disparities (e.g., age, socioeconomic status, racial minority background), particularly with regard to socioeconomic status and racial differences (Perrin & Duggan, 2015). For these reasons, the goal of developing Internet-delivered interventions is to broaden the scope of opportunity for interventions within diverse populations (Griffiths, Lindenmeyer, Powell, Lowe, & Thorogood, 2006), possibly reducing barriers to treatment encountered by individuals seeking traditional psychological intervention. Nevertheless, although developing Internet-delivered interventions improves access, they may not necessarily improve treatment rates or effectiveness, which is why continued investigation in this area of research is important.

Defining Internet-delivered interventions. There is a wide scope of services that are considered e-Mental health, broadly defined as "mental health services and information delivered or enhanced through Internet and related technologies" (Christensen, Griffiths, & Evans, 2002, p. 3). The services range from online activities such as access to health-related information or support groups, to online counseling and therapy, which allows clients to receive counseling online from a mental health provider. A comprehensive review of available services is beyond the scope of this paper (see Barak et al., 2009). The review of the literature that follows will focus on Internet-based interventions that are defined as interventions accessed by individuals seeking mental health services via online programs (Barak et al., 2009). The goal of these programs is to help the individual seeking services to improve their mental health through increased

knowledge, awareness, and understanding by accessing educational information and intervention programming online (Barak et al., 2009).

These web-based interventions are generally composed of four elements: (a) program content, (b) multimedia information, (c) interactive online activities, and (d) guidance and supportive feedback (Barak et al., 2009). Program content describes the nature of the information included in the program. Generally, two types of information are presented: educational content and content intended to create therapeutic change (Barak et al., 2009), which is usually accomplished through the use of multimedia information (e.g., audio, video, graphics, text). The provision of interactive online activities provides the user an opportunity to use the intervention in an interactive way, and although research is in its infancy, it is thought that by offering interactive activities, patient engagement and interest will be increased (Kerr, Murray, Stevenson, Gore, & Nazareth, 2006). The last component of web-based interventions is the guidance and supportive feedback that is provided, which describes how participants receive "external" feedback about their progress through the program. This can vary by type (e.g., automated or generated by a human), personalization (e.g., generic through individualized), and degree (e.g., high degree of feedback to no feedback and guidance).

Internet-delivered intervention subtypes. The following three intervention subtypes have been identified in a review of Internet-supported interventions by Barak and colleagues (2009): (a) web-based educational interventions; (b) self-guided web-based therapeutic interventions; and (c) human-supported web-based therapeutic interventions. Web-based education interventions are designed to provide information about a mental health or medical disorder. This would provide access to information

about diagnosis, symptoms, etiology, and treatments. The goal is enhancement of knowledge and understanding. Many of these interventions are static (e.g., use one or two multimedia formats). The amount of support provided varies widely; some interventions provide partial support by way of human or automated feedback, such as assessment for self-reported symptoms or access to a moderated forum/chat room for peer support.

Self-guided, web-based therapeutic interventions have the goal of impacting cognitive, behavioural, and emotional functioning, and promoting positive change across these domains. These interventions are generally modularized, highly structured, and developed on the foundation of the principles of traditional face-to-face interventions. They generally use multiple media formats and provide interactive activities. There is typically some degree of feedback/support via tests of progress or automated e-mails/SMS. The specificity of the feedback provided varies largely from none to partial (i.e., fairly generic/simple reminders, corrective/confirmatory feedback on activities, or diagnostic feedback) or high (i.e. reminders, confirmatory/corrective, diagnostic, explanatory, prescriptive, and elaborative feedback responses with specific recommendations for change; Barak et al., 2009).

Human-supported therapeutic web-based interventions also seek to create positive cognitive, emotional, or behavioural change in participants through the use of multimedia information and activities. The interventions incorporate a mental health professional, and provide support, guidance, and feedback throughout the intervention. This support is generally one-to-one (e.g., email, message, webcam); however, there is variability in the amount, frequency, and immediacy of support. A significant difference between self-guided and human-supported interventions is that human-supported interventions

generally require screening, registration, and sometimes payment to gain access to the program, given that they are individualized clinical treatment similar to face-to-face treatment.

Self-guided and human-supported interventions have their own advantages and disadvantages. For example, given that a mental health care professional is not required for the provision of the self-guided intervention, public health prevention and treatment is provided at low cost, with broad reach. Although human-supported interventions may not be as cost effective, or have as broad a reach, research has found positive associations between outcome and therapist contact (Palmqvist, Carlbring, & Andersson, 2007). Nevertheless, results from meta-analytic studies support the effectiveness of both human-supported programs and self-guided programs (Barak, Hen, Boniel-Nissim, & Shapira, 2008).

Effectiveness of Internet-delivered interventions. Internet-delivered interventions have been developed across several psychotherapeutic orientations for use in diverse populations with diverse referral questions such as smoking cessation (Walters, Wright, & Shegog, 2006), obesity and weight loss (Manzoni, Pagnini, Corti, Molinari, & Castelnuovo, 2011), and mental health disorders (Barak et al., 2008), such as anxiety and depression (Hadjistavropoulos, Pugh, Nugent, Hesser, Andersson et al., 2014). Meta-analysis of 92 studies investigating the effectiveness of Internet-delivered interventions across a wide range of problems and disorders, theoretical orientations, and delivery mode (e.g., e-therapy, self-guided interventions) demonstrated medium effect sizes across all primary outcome measures ($d = 0.53$; Barak et al., 2008). Given the heterogeneity of studies included in the meta-analysis, the researchers investigated potential moderating

variables. Moderating variables are important to investigate, given the possibility that Internet-delivered interventions may be more effective for specific problems (e.g., psychological or somatic disorder), within a specific orientation (e.g., cognitive behavioural therapy or psychoeducational), or with specific populations (e.g., age cohorts).

In terms of the characteristics of the website, the researchers found that the effect size for interventions with interactive rather than static websites had a significantly higher effect size, $d = 0.65$ and $d = 0.52$, respectively. However, the authors noted that this finding could be confounded by the therapeutic approaches more common to the interactive websites, rather than the program content itself. Static websites are generally characteristic of psychoeducational online interventions, whereas interactive websites are more characteristic of cognitive-behavioural therapy (CBT) and behavioural approaches (Barak et al., 2008).

In terms of the problems/disorders most effectively treated over the Internet, the meta-analysis demonstrated that online interventions may be most effective for psychological problems (e.g., anxiety) than for somatic or physiological problems (e.g., weight loss). Furthermore, in terms of therapeutic orientation, CBT was found to be significantly more effective than other approaches (i.e., psychoeducational and behavioural). More recently, meta-analyses and systematic reviews examining the effectiveness of Internet-delivered interventions for specific disorders, such as generalized anxiety disorder (GAD) and depression, have demonstrated positive outcomes (Hadjistavropoulos, Nugent, Alberts, Staples, Dear, et al., 2016; Richards, Richardson, Timulak, & McElvaney, 2015) and the continued utility and effectiveness of

Internet-delivered interventions. However, very little research has been conducted specifically on the effectiveness of Internet-delivered mindfulness programs.

With regard to participant demographics, age of participants was a significant moderator of effects. Specifically, younger adults (19-24 years old) and adults (25-39 years old) were more successfully treated with Internet-based interventions than youth (18 and under) and older adults (40 and above). The researchers suggested that these findings may not necessarily hold true over time as the pervasiveness of the Internet and development of the skills necessary to use an Internet-delivered intervention becomes more consistent across cohorts (Barak et al., 2008). The effects of Internet-delivered interventions have also been investigated specifically in university samples. Meta-analysis demonstrated computer-delivered interventions were effective at reducing anxiety, depression, and stress when compared to inactive control groups and neither the computer delivery intervention or active control group (e.g., face to face intervention, online support groups) were superior, suggesting that they are at least equally effective for depressions and anxiety (Davies et al., 2014).

Mindfulness

The concept of mindfulness is rooted in ancient Buddhist practice and philosophy; however, it was not until the 1960s and 1970s that Western scientists and practitioners began researching the relationship between meditative practice and attention in experimental psychology and utilizing meditation techniques in psychotherapy (for review, see Kabat-Zinn, 2003; Keng, Smoski, & Robins, 2013). In the 1970s, the work of Jon Kabat-Zinn and colleagues introduced the use of meditation and other contemplative practices as a component of clinical interventions to improve well-being (Kabat-Zinn,

1982). It has since become widely integrated into Western healthcare, in part due increases in mindfulness in the mainstream media.

Mindfulness is defined as "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 1990, p. 4). That concept has been studied as both a personality trait that varies between individuals and as a state that can be cultivated through practice and mindfulness meditation (Kabat-Zinn, 2013). Research suggests that heightening state mindfulness in meditation practice over time increases trait mindfulness, which in turn produces benefits to psychological health and well-being (Kabat-Zinn, 2013). As a trait, research has demonstrated an association between trait mindfulness and psychological health and well-being (Keng et al., 2013). Correlational research has also suggested an association between mindfulness and variables related to psychological well-being, such as life satisfaction (Brown & Ryan, 2003), self-esteem (Brown & Ryan, 2003), empathy (Dekeyser, Raes, Leijssen, Leysen, & Dewulf, 2008), and positive affect (Brown & Ryan, 2003), as well as negative associations with maladaptive traits, such as alexithymia (Baer et al., 2004), rumination (Raes & Williams, 2010), and poor emotion regulation (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). Following from the demonstrated associations with psychological well-being and increased interest in mindfulness as a clinical component, several mindfulness-based interventions (MBIs) have been developed and implemented across clinical and nonclinical populations.

As a secular practice, mindfulness-based training was developed in order to cultivate awareness and attention to the present moment with curiosity, openness, and acceptance, without expectation or focus on outcome (Kabat-Zinn, 2013). Mindfulness

helps to bring awareness and acceptance of experiences, including physiological sensations, thoughts, emotions, and events that are external to the individual (Baer, 2003; Cash & Whittingham, 2010). The premise of MBIs is that through mindfulness training individuals learn to focus their attention nonjudgmentally on the present moment, thereby reducing anxious rumination and other maladaptive and dysfunctional cognitive processes and behaviors (Kabat-Zinn, 2013).

Therapeutic effects of mindfulness-based interventions. The first MBI introduced as a secular practice in North America was mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982). MBSR was developed by Dr. Jon Kabat-Zinn at the University of Massachusetts as a complementary therapy to improve coping with chronic pain. Since that introduction, several interventions have been developed with mindfulness as a core component, such as mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002), as well as interventions that use mindfulness as a component but are less meditation-focused, such as dialectical behavior therapy (DBT; Linehan, 1993) and acceptance and commitment therapy (ACT; Hayes, Strosahl, & Wilson, 1999).

Traditional MBIs are commonly 8-week, group-format interventions that require a significant commitment of time and financial resources. Generally, MBIs require participants to attend weekly 2 to 2.5 hour-long sessions that involve psychoeducation, didactic instruction in mindfulness, and experiential training. Participants are also expected to complete 45-60 minutes of home practice each day for the 8-week duration of the intervention. The interventions also incorporate a day-long retreat towards the end of the program to allow extended practice with each of the meditation strategies. These

interventions typically include both formal 'intentional' practices each day and informal practices aimed to cultivate awareness in day-to-day functioning across activities of daily living (Kabat-Zinn, 2003).

MBIs have been implemented successfully in many different clinical and subclinical populations over the past 25 years, including psychological disorders such as anxiety (Khoury et al., 2013) and depression (Teasdale et al., 2000), behavioural disorders such as attention-deficit/hyperactivity disorder (ADHD; e.g., Cairncross & Miller, 2016), parents coping with a child with special needs (e.g., van der Oord, Bogels, & Peijnenburg, 2012), somatization disorder (Fjorback et al., 2013), and chronic pain (e.g., Veehof, Trompetter, Bohlmeijer, & Schreurs, 2016). Overall, MBIs have been found to be superior when compared to no treatment control groups, non-control groups (i.e. placebo groups), and active controls (i.e. other psychological treatmen); Goldberg et al., 2018). Additionally, MBIs were found to be equivalent to evidence-based treatments for anxiety and depression, and more effective than evidence-based treatment for smoking cessation.

MBIs have also been used with individuals who are psychologically healthy and seeking to increase emotional well-being (Keng et al., 2013). Randomized controlled trials examining the impacts of MBIs on psychological well-being have found it to be effective at improving psychological outcomes and emotion regulation in healthy adults and student samples (Keng et al., 2013). Despite the benefits associated with MBIs, researchers and clinicians conducting MBIs in higher education settings cite a number of challenges with compliance, such as high attrition rates, which might be related to student complaints such as scheduling conflicts, transportation to campus, and difficulty

managing the time commitment required for participation given academic obligations. As such, researchers have begun to investigate the effects of brief MBIs, which require significantly less time commitment.

A systematic review and meta-analysis found no relationship between length of in class sessions and effects of psychological distress for MBIs (Carmondy & Baer, 2009). Even direct comparison of 4-week to traditional 8-week MBIs found comparable effects for mindfulness and affect (Demarzo et al., 2017). Overall, brief MBIs have shown to reduce emotional distress and stress and improve mindfulness and self compassion when compared to waitlist controls (Greeson et al., 2014), and reduce negative affectivity/distress compared to active control groups (Jain et al., 2017; Schumer et al., 2018). A meta-analysis specifically investigating the effects of MBIs on negative affectivity found that length of practice and length program did not moderate the effects of the MBIs on outcomes (Schumer et al., 2018). Given the broad range of benefits of traditional and brief MBIs in both clinical and nonclinical populations, researchers have begun to investigate the effects of self- help and Internet-delivered mindfulness-based interventions to determine if similar effects are found in MBIs delivered online.

Internet-delivered mindfulness-based interventions. A review of the literature of self-help mindfulness and acceptance therapies (i.e. Internet-delivered intervention, self-help books, audio recordings) found improved mindfulness, and reduced depression and anxiety symptoms (Cavanagh et al 2014). More specifically, Internet-delivered MBIs (ID-MBIs) have been implemented in several populations, such as adults with mental health disorders, chronic pain, and cancer, and healthy individuals across multiple settings such as community dwelling-adults, post-secondary institutions, and workplace

settings (Spijkerman, Pots, & Bohlmeijer, 2016). The majority of these studies have assessed the interventions' impact on depression, anxiety, stress, and mindfulness as either primary or secondary outcomes.

A meta-analysis investigating the effectiveness of ID-MBIs for improving mental health outcomes included 15 randomized controlled trials (Spijkerman, Pots, & Bohlmeijer, 2016). The aim of that study was to estimate the overall effect size of ID-MBIs on depression, anxiety, stress, and general well-being. Overall, results suggested that ID-MBIs produced comparable effect sizes for stress as compared to traditional face-to-face mindfulness interventions, and reduced depression and anxiety but to a lesser degree (Spijkerman et al., 2016). The generalizability of these findings in regard to the current study may be limited due to the significant diversity across participants and interventions included in the meta-analysis. Participants included normal controls, psychiatric patients, and medical patients, and interventions varied from two weeks (i.e., two sessions) to eight weeks (i.e., eight sessions) in length. A meta-regression was completed to examine potential differences in effect sizes across populations and intervention type, but the authors recognize that these analyses may not have reached statistical significance given the small sample size. Thus, although preliminary evidence suggests ID-MBIs might help to improve psychological well-being, the research literature has not accounted for differences across diagnostic groups or individual differences that may impact compliance and effectiveness of the intervention.

Three randomized control trials have investigated the impacts of ID-MBIs in emerging adults/student populations. Cavanagh et al. (2013) conducted a brief two-week, self-guided ID-MBI in which 104 university students were assigned to a two-week online

mindfulness intervention or a waitlist control. Researchers included measures of mindfulness, perceived stress, anxiety, and depression. The intervention consisted of listening to a 10-minute audio track each day that contained a guided mindfulness meditation. Participants received emails at three-day intervals to remind participants to practice daily , as well as hints and tips for practice. Researchers found a significant increase in mindfulness, a decrease in perceived stress, and a decrease in self-reported symptoms of anxiety and depression compared to the control group. However, only 52.3% of participants completed questionnaires pre- and postintervention; 42.6% in the mindfulness group completed post intervention questionnaires compared to 70% in the control group. The researchers found no significant differences between completers and noncompleters on age, gender, or baselines scores of mindfulness, stress, anxiety, or depression.

Mak and colleagues (2015) conducted a randomized controlled trial to compare an 8-week mindfulness training, 8-week health action process approach (HAPA) with enhanced mindfulness, and waitlist control. The HAPA condition was identical to the online mindfulness program, with infusion of HAPA-specific guidelines aimed to increase planning and effectiveness of exercises by developing coping strategies to deal with obstacles and barriers to treatment that may be encountered. The impacts of the interventions on mindfulness, mental well-being, life satisfaction, perceived stress, anxiety, and depression were assessed in 321 university students and staff. The authors found that the HAPA-enhanced group demonstrated higher levels of mindfulness postintervention and at the 3-month follow-up, and significant increases on life satisfaction. Furthermore, the mindfulness and HAPA-enhanced mindfulness group

demonstrated improved mental well-being. No significant effect was found on perceived stress or psychological symptoms for any of the groups.

Messer, Horan, Turner, and Weber (2016) completed a randomized control trial investigating the effects of an Internet-delivered mindfulness intervention, relaxation training condition, and a no-treatment control group on stress, coping, and mindfulness. Participants were 114 undergraduate students. The interventions were three weeks in duration. Results indicated that both the mindfulness and relaxation groups had significantly reduced stress compared to the control condition. They also found that the mindfulness group demonstrated significant decreases in emotion-oriented coping, described as reactive behaviour to improve mood. Overall, recent research suggests that ID-MBIs may offer benefits for nonclinical groups; however, results have been mixed and these studies have focused largely on stress, depression, and anxiety.

Current Study

A transdiagnostic approach to mental health assumes that certain mental health difficulties, such as anxiety disorders and mood disorders, share similar underlying cognitive, emotional, and behavioural processes, all which contribute to the development and maintenance of the disorder. Thus, it is not surprising that many disorders share similar symptoms and/or clinical presentation, or are commonly comorbid (e.g., anxiety and depression). MBI is a transdiagnostic model for intervention focused on observing experiences and internal states without trying to change them or wishing they were different (Kabat-Zinn, 2003). Thus, the model in many MBIs is not focused on reducing specific symptoms (Bishop, 2002), increasing the likelihood that mindfulness training may be helpful across diverse populations and clinical presentations. Given this broad

range of benefits of traditional MBIs, the goal of the present study was to develop an Internet-delivered MBI (ID-MBI), with the goal of providing a cost and time efficient service to university students that reduced barriers to psychotherapeutic treatment. The present study was the first to examine the effectiveness of an ID-MBI to improve emotion regulation, affect, and psychological flexibility in postsecondary students, and clarified its effects on a broad range of psychological symptoms, such as general emotional distress and perceived stress.

The present study was the first, to this author's knowledge, to more objectively measure compliance with an ID-MBI via program usage data. Program usage data, in this study, was compared to retrospective reports of compliance, to determine if these measures differ from one another, given that most therapeutic research has relied on self-report data despite significant limitations (i.e., bias). Furthermore, given that individual difference factors that impact the effectiveness of MBIs have largely been neglected in the literature, the current study examined factors that impact effectiveness of this program. This is an important area of study, particularly for Internet-delivered interventions given the high attrition rates typically found in Internet-delivered interventions (Christensen, Griffiths, & Farrer, 2009; Waller & Gilbody, 2009).

The reader is encouraged to note that this dissertation was a compilation of three individual chapters that are tied together thematically. The following chapter is an overview of the study procedures. All data were collected for each of the subsequent study chapters (Chapters 3, 4, and 5) as part of one large investigation. Enrollment in the intervention was continuous until the predetermined sample size by a priori power analyses was reached (n = 70). To ensure adequate power and account for attrition

(estimated at 20%), additional participants were collected (n = 84). As such, Chapter 2 provides detailed information with regard to the procedures and interventions. Subsequent chapters for each study have methods and data analyses sections unique to each study's aims and hypotheses. The third, fourth, and fifth chapters are intended to be stand-alone manuscripts suitable to be submitted for peer review and scholarly publication. As such, some overlap exists in the literature reviewed.

CHAPTER 2

Procedures

Participants were enrolled from the University of Windsor's psychology department participant pool (i.e., potential participants from various disciplines who are taking psychology courses at the University of Windsor who are offered the opportunity to participate in research as a part of their educational experience) from September 2017 to June 2018. Exclusionary criteria were not having daily access to the Internet and/or currently participating in psychotherapy or counseling. Eligibility for participation based on these exclusion criteria was determined by a screening questionnaire completed by pool participants prior to signing up for the study.

Once eligibility was determined participants were randomly assigned to the Internet-delivered MBI (ID-MBI) or a waitlist-control condition (WCC) using stratified randomization (1:1) and informed consent was completed (Appendix A). Stratified randomization was implemented to ensure good balance of participant characteristics in each group. A separate randomization procedure was completed for participants who identified as male or female, to avoid imbalance of sex across trials given the relatively larger percentage of female participants in the University of Windsor's psychology participant pool.

All participants completed a baseline assessment in person, which included information regarding relevant demographic characteristics (e.g., age, sex, level of education, ethnicity, see Appendix B) and the measures described in each of the following study chapters. Demographic characteristics were collected for the purpose of describing the sample and were used to investigate potential characteristics that may

impact compliance or effectiveness of the intervention.

Participants assigned to the ID-MBI group received the 4-week intervention as described below (See Interventions). The WCC did not receive any active intervention, but were assessed at similar intervals (i.e., baseline, posttreatment). At postintervention follow-up, participants in the treatment group completed all of the preintervention baseline measures (except personality measures), the retrospective report of compliance to practice, and a participant satisfaction questionnaire, adapted for use within the current research project (Client Satisfaction Questionnaire [CSQ], see Appendix C). At follow-up, the WCC also re-completed all of the preintervention baseline measures, with the exception of the personality questionnaire. Following the postintervention assessment, participants assigned to the WCC were offered access to the mindfulness programming.

Participants assigned to the ID-MBI and WCC received 3.0 bonus points for participation. Participants in the WCC who opted to complete the intervention with support from the researcher and return to the lab for an additional assessment (total participation length 8 weeks) were not offered additional compensation beyond 3.0 bonus points as per the participant pool researcher guidelines. These participants were given the screener questions again (i.e., "Do you have daily access to the Internet?" and "Are you currently participating in psychotherapy?") to ensure that the participants still met inclusion criteria.

Intervention

Internet-delivered mindfulness-based intervention (ID-MBI). Participants who were randomly assigned to the experimental group participated in a 4-week Internet-delivered MBI (see Appendix F) . Participants were provided an online training module

whereby they had access to weekly psychoeducation about mindfulness skills and audio-recorded mindfulness practices to complete daily for the 4-week period. During the program phase, participants were asked to complete practice logs after each practice and their activity with the intervention was recorded (e.g., time spent listening to audio recordings). The intervention was modeled on components of mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982) with modifications similar to Rogers and Maytan's (2012) Koru Mindfulness program, which was designed for use with college/university students and emerging adults. The program was based on the structure of Koru Mindfulness (i.e., Introduction and four modules), such that each module included didactic information, skills training of a specific mindfulness exercise, and completing and submitting practice plans. The introduction module, also adapted from the Koru Mindfulness program, included psychoeducation about mindfulness and its benefits. Furthermore, the intervention adopted the 4-week format of Koru Mindfulness as research has shown that brief mindfulness interventions have similar effect sizes as 8-week traditional interventions, and the 4-week program had higher compliance and less attrition in emerging adults/university students (Rogers & Maytan, 2012).

Participant engagement was encouraged by contact with the researcher. Each participant was emailed at the end of each module to indicate they could complete their practice logs and start the next module. Additionally, if three days passed and a participant had not logged on to the website to practice, they were sent an email by the researcher that indicated that they had not practiced in several days with encouragement to continue to practice or help to problem-solve around barriers to practicing. If the participant did not respond to the message or log on to the program within the following

72 hours, another email was sent to follow-up to encourage continued participation. If the participant did not respond, an email was sent to the participant indicating that they would not receive any additional follow-up emails. This procedure was intended to help keep participants engaged, build rapport, and reduce attrition rates. The website also included a section that provided participants with services (i.e., 24-hour crisis line and psychotherapy services) should they become distressed while participating in the program (See Appendix E).

The specific content of the modules (i.e., didactic information) was developed by the primary investigator (MC) and the research supervisor (CM). The guided mindfulness exercises were provided by a variety of sources with their permission, including Dr. Carlin Miller (University of Windsor), Dr. Steve Hickman (University of California, San Diego, Center for Mindfulness), and Ms. Diana Winston (Director of Mindfulness Education at University of California, Los Angeles Mindful Awareness and Research Center).

During preintervention assessment and orientation, which was held in person, participants received psychoeducation about mindfulness, orientation to the program, and the researcher's expectations for participants (e.g., will access each new module at the beginning of each week, complete schedule for practice, complete practice logs). Each module adhered to the following format: brief psychoeducation about mindfulness, specific skill training, completion of practice plan, daily practice, and completion of a practice log at the end of each module. The brief psychoeducation was a structured lesson provided in text format that involved an introduction to the mindfulness skill for the week, a brief psychoeducation component about the skill, followed by an audio

recording leading a practice in the skill. After reading the lesson plan for the week, participants were asked to complete a practice plan that included the time of day they would allocate for daily practice. Participants were provided with audio-recorded guided mediations related to the skill that they were asked to practice five days each week. Participants were asked to practice approximately 10 minutes of formal mindfulness practice for at least five days each week. When a participant clicked on a guided exercise, a new window opened where the audio began playing immediately and underneath was a text box. After using one of the guided exercises they were asked to record how long they had practiced using the exercises by typing the total minutes they spent meditating into the provided text box. Opening the exercise and submitting the self-reported length of the meditation, submitted the assignment to the researcher via email. Below is a description of each module content.

Module 1. The first day of this module included didactic information, skills training: mindful breathing, and submission of the practice plan for the first week. Participants were asked to listen to an audio-recorded mindfulness exercise on at least five days that week related to mindfulness of breath, followed by submitting the total time they practiced to ensure the audio-recording was completed.

Module 2. The first day of the second module included didactic information, skills training: body scanning, and submission of the practice plan for the second week. Participants were asked to listen to an audio-recorded mindfulness exercise on at least five days that week related to body scanning, followed by submitting the total time they practiced to ensure the audio-recording was completed.

Module 3. The first day of the third module included didactic information, skills training: awareness of emotions/thoughts/bodily sensations, and submission of the practice plan for the third week. Participants were asked to listen to an audio-recorded mindfulness exercise on at least five days that week related to awareness, followed by submitting the total time they practiced to ensure the audio-recording was completed.

Module 4. The first day of the fourth module included didactic information, skills training: self-compassion, and submission of the practice plan for the final week. Participants were asked to listen to an audio-recorded mindfulness exercise on at least five days that week related to self-compassion, followed by submitting the total time they practiced to ensure the audio-recording was completed.

Wait-list control condition. Participants who were randomly allocated to the WCC did not receive any active treatment. They were informed that they would receive the ID-MBI following the 4-week follow-up assessment if they wished. At the postintervention assessment they were provided with three options: (1) to complete the intervention with the support of the researcher and return after 4-weeks to complete a postintervention assessment that included the baseline measures, retrospective report of compliance to practice, and the Client Satisfaction Questionnaire, (2) to complete the intervention on their own and have no additional contact with the researcher, or (3) to decline the intervention (see Figure 1). Data collected from WCC participants who completed the intervention (i.e., option 1) were not included in the subsequent analysis.

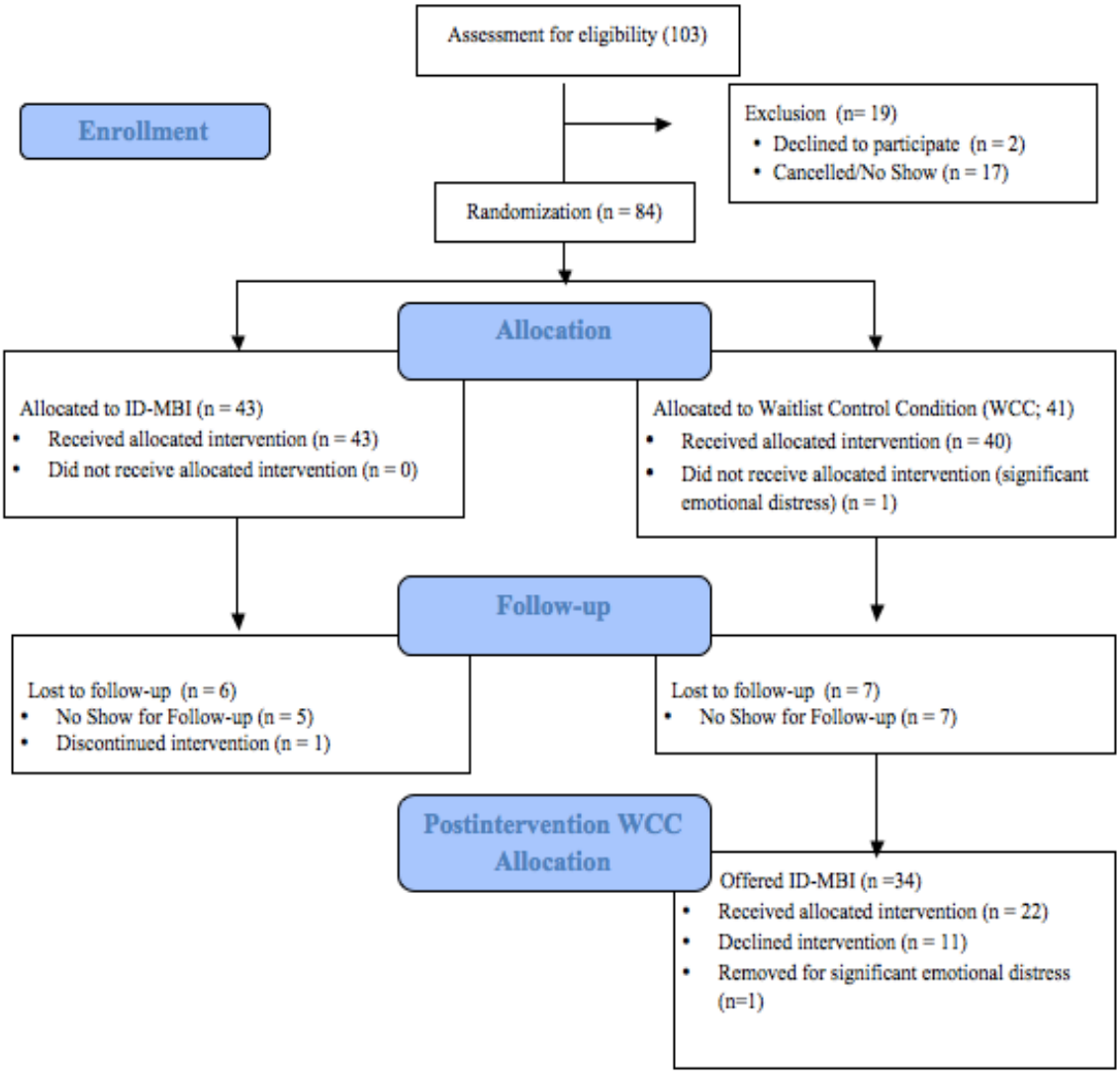

Figure 1. CONSORT Flow Diagram: Flow of participants through the trial; Internet-delivered mindfulness-based intervention (ID-MBI), 4-week online mindfulness intervention.

CHAPTER 3

Study I: Comparison of a computer-timed measure of compliance and subjectively reported compliance to an Internet-delivered mindfulness-based intervention

Assignment of therapeutic homework has been considered an integral component of psychological intervention and has been characterized as one of the most common clinical strategies used in psychotherapy (Kazdin & Mascitelli, 1982). This remains true independent of the therapeutic orientation and clinical presentation of the individual participating in the intervention (Kazantzis & Ronan, 2006). The purpose of homework in-between therapy sessions may differ based on orientation; however, it is generally used to implement newly acquired skills or beliefs outside of the therapeutic context. For instance, the purpose of homework in cognitive-behavioural therapy (CBT) is to practice newly acquired skills, replace previously identified skills that are dysfunctional, test out ideas and beliefs, and implement new skills across different domains to improve functioning across diverse situations outside of the therapy session (Beck, Rush, Shaw, & Emery, 1979).

Although homework is commonly assigned to clients, clients may not always complete assigned homework between sessions. Compliance, defined as the extent that clients implement or complete the recommended homework between sessions, has been shown to be important to therapeutic outcomes (Kazantzis, Deane, & Ronan, 2000) such that completion of homework in psychotherapy has been shown to improve treatment outcome (Kazantzis et al., 2000; Mausbach, Moore, Roesch, Cardenas, & Patterson, 2010). Reviews of the literature have examined the impacts and importance of homework in behavioural therapy, cognitive-behavioural therapy, emotional-focused experiential

therapy, psychodynamic therapy, and systems-oriented individual psychotherapy (Kazantzis et al., 2000), but less work has investigated the importance of homework compliance in mindfulness-based interventions (MBIs).

Homework in Mindfulness-Based Interventions

Traditional MBIs such as mindfulness-based stress reduction (MBSR: Kabat-Zinn, 1990) are 8-week, group-format interventions that require participants to attend weekly 2 to 2.5 hour-long sessions that involve psychoeducation, didactic instruction, and experiential training in mindfulness. Most programs also require a day-long silent retreat near the end of the programming. Participants are also expected to complete 45-60 minutes of home practice each day (i.e., homework). These interventions typically include both formal 'intentional' practices and informal practices aimed to cultivate awareness in day-to-day functioning across activities of daily living (Kabat-Zinn, 2003).

Adherence to intervention and regular at-home practice is assumed to be an essential component of MBIs and the development of mindfulness skills (e.g., Carmody & Baer, 2008). Yet, little research has been conducted to investigate this proposition. An empirical review (Baer, 2003) examining the relationship between time spent practicing mindfulness skills outside of the therapeutic session and clinical outcomes, reported three studies with equivocal findings (e.g., Astin, 1997; Kristeller & Hallet, 1999; Speca, Carson, Goodey, & Angen, 2000). Furthermore, none of these studies reported the impact of practice with validated measures of mindfulness (Baer, 2003). Since this early review, researchers have continued to acknowledge the inconsistency between the clinical assumptions about mindfulness practice and outcomes, and the available empirical support (e.g., Vettese et al., 2009).

Compliance to Mindfulness-Based Interventions

A review of literature investigating the association between clinical outcomes and home practice in MBIs (Vettese et al., 2009) identified 24 studies that examined the relationship between home practice and clinical outcomes. Of the studies reviewed, homework practice was tracked via daily self-report logs (n = 15), retrospective report (n = 11), weekly report forms (n = 2), and daily diary and monitoring of practice by phone (n = 1). In terms of actual reported home practice compliance only six studies provided relevant data. In these studies, compliance was reported using various techniques, such as asking participants to endorse whether they practiced at least 45 minutes a week (Carmody, Crawford, & Churchill, 2006), yes or no questions about if they have kept up with practice (Kabat-Zinn et al., 1992), or reported anecdotal compliance as generally appearing high or low (Davis, Fleming, Bonus, & Baker, 2007; Ramel, Goldin, Carmona, & McQuaid, 2004), revealing inconsistent and unreliable measures of homework compliance.

In terms of the association of practice with clinical change, Vettese and colleagues (2009) reported 54% of the studies demonstrated partial support for the relationship between practice and clinical outcomes, and 46% did not find the expected outcome (i.e., practice was not related to clinical change). Differences in methodology between these studies that could have accounted for these unexpected findings were suggested. For example, several of the studies that did not find an association between practice and clinical outcome had small sample sizes, one study involved a 10-day retreat rather than a weekly intervention, and several utilized participants that were referred by a practitioner, or were students/employees in the health care field, which the researcher

posits could have impacted the results given they are more familiar with the concept of mindfulness (Vettese et al., 2009). Furthermore, studies that investigated the association of home practice and reported changes in mindfulness were limited (n = 3); only two demonstrated a relationship between practice and increases in self-reported mindfulness (Vettese et al., 2009).

Since the publication of this systematic review, several studies have been published investigating the link between practice and therapeutic outcome. For example, a study investigating the impact of between-session practice on mindfulness following a mindfulness-based relapse prevention program for adults in outpatient treatment for substance abuse demonstrated that between session practice predicted levels of mindfulness at postintervention, but not at the two- or four-month follow-ups (Bowen & Kurz, 2012). The study implemented self-report measures of mindfulness and amount of practice was assessed retrospectively postintervention with a nonvalidated measure of homework completion. Thus, although research has investigated the impact of reported homework compliance on clinical outcomes in MBIs, the limitations of the methods of assessment have potentially led to these equivocal findings and demonstrate the difficulties of assessing compliance in psychotherapy research.

Several limitations exist within this compliance literature. First, the impact of homework compliance on clinical outcomes is generally a secondary analysis conducted within a larger study (Vettese et al., 2009), raising concerns about the potential post-hoc nature of these analyses (e.g., lack of reliable and valid methods of assessment in the evaluation of homework compliance, reliance on retrospective reports). Second, although many empirical studies attempt to assess the impacts of homework compliance on

treatment outcome in MBIs, they most often implement self-reported homework compliance. Relying on self-reported homework compliance raises a number of challenges. Self-report measures of compliance may be unreliable given the potential for bias or exaggeration (Kazantzis, Deane, & Ronan, 2004). Moreover, retrospective ratings are generally not validated measures and are also vulnerable to biases, such as the halo-effect (i.e., report of homework compliance impacted by positive outcomes experienced) and biases related to subjective emotional experience or perceived changes from the intervention (Bryant et al., 1999; Kazantzis, Ronan & Deane, 2001; Thase & Callan, 2006). Third, research has shown that the relation between homework compliance and outcomes is impacted by the source of the rating and timing of rating. For example, client reports have larger effect sizes compared to therapist ratings and retrospective ratings have larger effects than daily ratings (Mausbach, 2010). Thus, homework compliance is assumed to be essential to MBIs; however, the status quo of compliance measurement within the literature have significant limitations that may have led to equivocal research findings regarding the impacts of amount of homework practice on clinical outcomes.

Compliance in Internet-Based Mindfulness Interventions

Research investigating Internet-delivered mindfulness-based interventions (ID-MBIs) and homework compliance have similar methodological limitations. For example, the use of self-reported completion of homework is widely implemented across ID-MBIs to assess compliance (e.g., Cavanagh et al., 2013). However, the use of the Internet as a platform to provide treatment provides a unique possibility to assess individual participant usage data to better estimate compliance.

In the last several years, researchers have begun to make use of this unique feature. For example, Mak et al. (2015) tracked use of a mindfulness program via unique login IDs, but only reported that there were no significant differences between their groups on number of days participants spent on the website. Another study of an ID-MBI required participants to click on a link that would appear after completing the assigned audio exercises to assess compliance. Participants were unable to fast-forward to the end of the track and if the link was not clicked within five minutes of completion of the exercise it disappeared (Messer et al., 2016), but the researchers did not report these data. A two-session acceptance and commitment therapy (ACT) program collected the number of logins, pages viewed, amount of time spent on each page, and responses to completed lessons in the program (Leven et al., 2014); however, the researchers only reported that no differences were found between the intervention group and waitlist participants (after the waitlist participants completed the intervention) on program use. Although useful data have been collected, none of the aforementioned studies have reported results describing the total time spent practicing mindfulness exercises. Furthermore, researchers have assessed feasibility and usage via number of logins and login time, but this is not indicative of actual practice time.

No previous studies of ID-MBIs have used time spent practicing guided mindfulness exercises as a computer-timed variable for homework compliance (i.e., practicing mindfulness every day). Furthermore, this computer-timed measure has not been compared to self-reported data to determine if there is a discrepancy between self-reported completion of mindfulness practice and a computer-timed measure of recorded homework compliance; therefore, it is still unknown whether self-report data are a valid

measure of homework compliance in MBIs. Although time spent listening to guided mindfulness exercises is not a perfect measure of compliance because it is not possible to ensure that the participant's full attention is directed towards the exercise, it is believed to be the most accurate computer-timed measure of practice currently available to researchers. Given that it is not possible to measure compliance directly, this serves as a good computer-timed measure to indirectly assess how much individuals are practicing mindfulness exercises. Furthermore, getting distracted and redirecting attention back to the present moment during the guided mindfulness exercises is a natural part of developing and practicing mindfulness skills. For this reason, being distracted by something else during the practice is not necessarily considered to be noncompliant if attention is redirected back to the activity. In order to determine if individuals have redirected their attention back to the exercises or that participants have remained engaged with the guided meditation, the participants will be required to report how long, in minutes, they practiced immediately following the practice. The timing of this response will serve to indicate whether the participant completed the whole exercise or whether the participant completed the exercise without becoming distracted or disengaged for long periods of time. The researchers intentionally used the report of time, rather than asking participants to rate how well they engaged with the exercise or to describe the quality of their practice, to reduce the possibility of taking individuals out of the mindful state following practice. Asking the participant to evaluate the experience would be contrary to the experience of mindfulness, which asks one to take a non-non-judging stance toward their experiences. The answer must be provided within five minutes of the exercises

completion for that specific practice to be considered an accurate reflection of time spent practicing.

Study Aims and Hypothesis

The current study's aim was to investigate a novel computer-timed measure of compliance with an Internet-delivered mindfulness-based intervention and to determine if the computer-timed measure agreed with the most commonly used approach to assessment of compliance in psychotherapy research (i.e., retrospective reporting and daily reporting)**.**

Hypothesis 1. Agreement between subjectively reported daily compliance and retrospectively reported compliance will be low.

Hypothesis 2. Agreement between subjectively reported compliance (retrospective) and the computer-timed measure of compliance to the intervention (i.e., time spent listening to guided mindfulness exercises) will be low.

Methods

Participants

The aim of this study was to determine the level of inter-rater agreement of homework compliance rated by two judges (i.e., the participant and the computer algorithm). When each rater provides one rating, a minimum sample size of 36 participants would be required to achieve the statistical significance for an alpha-value set at 0.05 and with the minimum power of at least 80.0% (Bujang & Baharum, 2017), when the level of agreement between the raters is set to be 0.4 (poor agreement). The level of agreement between raters was set to 0.4 as a low estimate because no level of agreement between measures of compliance were available in the existing literature.

Participants ($N = 37$, $n_{female} = 32$) aged 18-49 years old ($M = 22.0$, $SD = 5.30$) were enrolled from the University of Windsor's psychology participant pool from September 2017 to June 2018. Participants identified as 54.1% Caucasian, 21.6% Arabic/Middle Eastern, 10.8% Hispanic, 5.4% East Asian, 5.4% South Asian/Indian, and 2.7% as Black/African American. Participants ranged from first to fifth year students (18.9% in first year, 13.5% in second year, 35.1% third year, 27.0% fourth year, and 5.4% fifth year; see Table 1 for demographic variables). Participants included in these analyses were only those from the larger study who were randomly assigned to the mindfulness intervention. Exclusionary criteria were not having daily access to the Internet and/or currently participating in psychotherapy or counseling. Eligibility for participation based on these exclusion criteria was determined by a screening questionnaire completed by pool participants prior to signing up for the study.

Measures

Demographics. Participants completed a demographic questionnaire at baseline that included age, sex, ethnicity, years of education, language, and mindfulness/meditation experience (see Appendix B). These data were used to describe the sample. Furthermore, if outliers or influential observations were noted, demographics variables may have been used to help understand the mechanism.

Daily compliance. The participants completed a practice log immediately following mindfulness practice throughout the four weeks of the intervention that was built into the online platform. After practicing, participants were asked to record, in minutes, how long they practiced the mindfulness activity. The cumulative time spent practicing was used in the analysis (i.e., total minutes) as the daily compliance measure.

Retrospective compliance. At the conclusion of the study, participants completed a paper-pencil questionnaire that asked them to report how many minutes on average they practiced mindfulness exercises across the 4-week intervention (see Appendix D). The participants were asked to do this without access to their daily logs of homework practice. This report provided one number for the total time spent practicing for the 4 weeks, which was used in analysis (i.e., total minutes).

Computer-timed compliance measure. I created a novel computer-timed measure of compliance with the intervention by calculating the participant's activity with each module. Each participant was assigned a unique ID and password to access the intervention online. The participant's completion of mindfulness assignments was determined via their ID. When participants started and submitted their mindfulness exercises, an email was sent from the program with a time-stamp. I used this to determine how long the audio-recorded mindfulness activities were used (i.e., from the time the exercises was started and stopped) and how many days the participant used the audio recorded interventions to practice their mindfulness skills. The time spent listening to the audio-recorded mindfulness exercises was calculated by subtracting the time the assignment was submitted from the time the assignment was started. If the time exceeded five minutes beyond the length of the exercise (e.g., a 5-minute exercise started at 3:00 p.m. and submitted at 3:30 p.m.), then it was considered to be an incomplete exercise, and scored as 0 minutes spent practicing. This type of adjustment for the computer-timed compliance occurred a total of 76 times across the four weeks, with an average of 2.05 times per participant (range 0-7 adjustments per participant). If the time did not exceed five minutes beyond the length of the exercises (e.g., a 5-minute exercise started at 3:00

p.m. and submitted at 3:06 p.m.), then it was considered a complete exercise and a score of 5-minutes spent practicing was assigned to the participant for that day. Thus, as long as the assignment was submitted within five minutes after the audio completed, the length of that exercise would be considered the computer-timed practice time. However, if the participant opened the exercise and submitted before the exercise would be completed (e.g., a 5-minute exercise started at 3:00 p.m. and submitted at 3:02 p.m.), then the time it was opened was considered the practice time, in this case 2 minutes. The total time in minutes across the four weeks was used as the computer-timed measure of compliance in the following analyses. Given the nature of this measure, in some cases the computer-timed and subjective report of compliance were identical. For example, if a participant started a 5-minute exercise at 3:00 p.m., submitted it at 3:06 p.m., and reported practicing for 5-minutes, then both the subjective and computer-timed measure of compliance for that data point would be 5-minutes.

Procedures

Participants were recruited through the departmental research participant pool. Participants who met eligibility criteria were randomly assigned to the mindfulness intervention or waitlist condition upon arrival for the preintervention assessment. Following completion of the intervention, participants in the waitlist group were offered the programming. See chapter 2 for detailed procedures. The University of Windsor Research Ethics Board approved all procedures.

Data Analysis

Agreement testing. The data were represented in two ways: (a) graphically using the Bland-Altman approach (Bland & Altman, 1986) to examine observed differences

between the paired measurements and (b) statistically by calculating intraclass correlation coefficients (ICC) to assess agreement between the measures of compliance.

To visually inspect the differences between the measures of compliance, the Bland-Altman approach suggests plotting the two sets of measures with the Y=X line. If measures are comparable they lay close to the line. Next, the difference between the pair of measurements was plotted against their mean. If the measurements are comparable, the differences should be small and centered around 0, and show no systematic variation with the mean of the pairs (Bland & Altman, 1986). The 95% limits of agreement (mean +/- 1.96 *SD*s) are plotted. Proportional bias was assessed by visually inspecting the distribution of the data across the range of the measures. A slant would suggest that proportional bias exists (i.e., increased variability with score magnitude).

Following visual inspection of the above graphs, ICCs were calculated in order to statistically assess agreement between the three measurements of compliance data with regard to total number of minutes practiced (i.e., subjective and computer-timed). ICC provides a useful methodology for analyzing consistency or conformity between measurements and allowed the researcher to determine if concordance is greater than chance.

Two ICCs were calculated: (a) for the retrospective report of compliance and objective-computer-timed compliance and (b) to compare subjective daily report and retrospective report of compliance. A third ICC was originally proposed to compare the computer-timed -measure and subjective daily report of compliance; however, based on the definition of the computer-timed measure, it was not possible for a participant to underestimate their daily reported compliance as compared to their computer-timed

report, so the distribution of the differences was heavily positively skewed. For this reason, the third ICC was not calculated. ICC estimates and their 95% confident intervals were calculated using SPSS statistical package version 23 (SPSS Inc, Chicago, IL) based on single-rating ($k = 2$), absolute agreement, Two-way Mixed Effects Model. A reliability index of ≥ .75 was considered excellent reliability, .60 to .74 is good reliability, .40 to .59 is fair reliability, and ≤ .40 is poor (Cicchetti & Sparrow, 1981).

Assumption testing. Prior to conducting the primary analyses, missing data were examined by conducting a Missing Value Analysis. No data were missing. Following, the assumption of the Bland-Altman approach was assessed, which is that the distribution of the differences is approximately normal (e.g., histogram of the differences). Based on visual inspection of the histogram, as suggested by Bland & Altman (1999), the difference scores were approximately normal.

The assumptions of intraclass correlations were also tested. This includes dependent variables measured on interval level, univariate normality of variables (e.g., histograms, boxplots), and homogeneity of variance (e.g., Levene's test). Normality of variables was assessed by visually inspecting histograms and box plots, as well as analyzing skewness, kurtosis, and the Shapiro-Wilk statistic. The Shapiro-Wilk statistics were nonsignificant for computer-timed time, daily reported time, and retrospectively reported time ($p > .05$). The skewness and kurtosis values for computer-timed and daily reported time were within the conventional cut-offs (i.e., skewness less than |2|, and kurtosis less then |3|). Retrospectively reported time was slightly skewed (i.e., skewness = 2.10), but the kurtosis value was within an acceptable range. Examination of histograms and box plots indicated adequate distributions with very few potential outliers. To assess

outliers, *z*-scores were calculated. One outlier was identified on the retrospectively reported time (*z*-score = 3.10). The analysis was conducted with and without the outlier, and results were not significantly impacted. Thus, the outlier was kept in the analysis to retain sample size. The assumption of homogeneity of variance was assessed by Levene's test of homogeneity of variances. The assumption was not violated ($p > .05$).

Results

Agreement testing. Bland-Altman plots and ICC's are presented below to assess the agreement between computer-timed and retrospective compliance and retrospective and daily compliance.

Daily and retrospective compliance. See Figure 1 for Y=X plot and Figure 2 for B-A plot. The mean difference was -15.81 and the 95% limits of agreement were -131.06 to 99.44. The points on the Bland-Altman plot were scattered approximately symmetrical above and below the mean difference score suggesting that there is no bias of one approach versus the other. The single measures ICC was .729 with a 95% confidence interval from .535 to .850 ($F(36, 36) = 6.639$, $p < .001$). Therefore, contrary to hypothesis 1, an excellent degree of reliability was found between retrospective and daily measurements of time spent practicing mindfulness.

Computer-timed and retrospective compliance. See Figure 3 for Y=X plot and Figure 4 for B-A plot. The mean difference score was 27.19 and the 95% limits of agreement were -131.00 to 158.38. The points on the Bland-Altman plot were scattered approximately symmetrical above and below the mean difference score suggesting that there is no bias of one approach versus the other. The single measures ICC was .407 with a 95% confidence interval from .114 to .639 ($F(36,36) = 2.49$, $p = .004$). Therefore,

contrary to hypothesis 2, a fair degree of reliability was found between retrospective and computer-timed measurements of time spent practicing mindfulness.

Post-hoc analyses. To assess for potential biases in self-reported compliance, correlation analyses were conducted between retrospective report of practice and measures of emotional distress and negative affect. No relationship was found between postintervention levels of emotional distress or negative affect and retrospective report of practice, suggesting retrospective report of practice was not related to mood at the conclusion of the intervention. With regard to factors that impacted time spent practicing, higher computer-timed time spent practicing was negatively related to stressful life events over the month of the intervention ($r = -.350, p < .05$), indicating that students who reported fewer stressful life events engaged in more mindfulness practice.

Discussion

This was the first published study to assess the agreement between various measures of homework compliance commonly used in intervention studies, and more specifically, the first study to report a more objective computer-timed measure of homework compliance to a mindfulness intervention delivered online. Agreement between the measures of compliance ranged from fair to excellent. An excellent degree of reliability was found between self-reported retrospective and daily measurements of time spent practicing mindfulness. The retrospective and objective computer-timed compliance measures showed fair agreement. This suggested that although the participants were consistent with daily and retrospective reporting, their report of compliance did not have as high agreement with the computer-timed measure of compliance obtained from the program usage data.

With regard to the retrospective and daily measurements, an excellent degree of reliability demonstrates that there was not a large difference between subjective daily and retrospective report of compliance by participants. Participants reported similar compliance whether they provided estimates right after practice or at the end of the 4-week intervention. This finding suggests that whether researchers use daily or retrospective report of homework compliance in research, there are likely to be similar results. This is an important finding given that there is no consistent standard for assessing or reporting compliance to interventions (Vettese et al., 2009).

Retrospective and computer-timed compliance showed only fair agreement. This suggested that although the participants were consistent with daily and retrospective reporting, their report of compliance did not have as high agreement with the computer-timed measure. In general, participants tended to over report compared to the computer-timed measure. This could be because the computer-timed measure is more conservative. If a participant did not complete the mindfulness exercise by submitting the total time practiced within five minutes of the exercises completion, it was assumed that the participant did not complete the entire assignment and a computer-timed score of 0 minutes was assigned for that activity. Despite the more conservative measure, the agreement with participant retrospective self-report was fair.

Few previous studies have compared the relation between multiple measures of compliance. Studies examining correlations between client and therapist report of compliance have been somewhat mixed with some research finding significant correlations (Burns & Nolen-Hoeksema, 1991; Holtzworth-Munroe, Jaconseb, DeKlyen & Whisman, 1989), and one study finding no significant relation between the measures

(Jazdin & Mascitelli, 1982). A study examining the correlation between participant and observer compliance ratings (i.e., whether written assignments were completed or not completed) showed high correlation in the context of CBT for depression (Neitmeyer et al., 2008). Only three studies have attempted to compare participant self-report homework compliance with an objective measure of compliance in the context of relaxation for hypertension (Hoelscher et al., 1984, 1986) and anxiety (Taylor et al., 1983). Overall, although the studies find that self-report ratings correlate with monitored practice, these studies suggested a tendency to over-report or exaggerate self-reported homework compliance (Hoelscher, Lichstein, & Rosenthal, 1984, 1986; Taylor, Agras, Schneider, & Allen, 1983). These aforementioned studies used cassette players with internal monitors to calculate the amount of time the cassette was played but were unable to monitor if the cassette was played and not listened to, and had no way to ask questions following use of the relaxation exercises to determine if the participant was still engaged. In contrast, the findings of the current study suggest that within the context of the online mindfulness intervention, the participants were generally reliable reporters of at-home practice.

The findings, which demonstrated the clinical utility of various methods of assessing homework compliance, have important implications within the context of intervention research. The findings indicated that both daily and retrospective report of compliance may be accurate measures of compliance. Furthermore, the computer-timed measure of compliance clarified that compared to a conservative computer-timed measure of compliance, participants were fairly accurate at reporting compliance to the intervention. This has important implications for the overall mindfulness literature given

the suggestions that compliance cannot be compared across studies due to the heterogeneity of measurement (Vetesse et al., 2009). These findings suggest that researchers can be more confident in comparing compliance across studies due to relatively good degree of reliability between these measures, specifically for online interventions. We can also be more confident that participants are fairly accurate at reporting compliance when using guided meditations. Additionally, affect and emotional distress at the time of retrospective reporting of compliance did not appear to bias participant report of compliance. Interestingly, the number of stressful life events reported across the 4-week intervention was associated with computer-timed time spent practicing. Specifically, fewer stressful life events were associated with more practice. This suggests that participants with less life stress were able to engage more regularly with the intervention.

Results of the present study should be considered within the context of its limitations. First, the confidence intervals for the ICC's were large, suggesting that sample size may have been small leading to a large standard error. A larger sample may lead to more precise reliability indices. However, this could also be related to the nature of the measures, such that some participants either seemed relatively consistent in their compliance report, and some tended to overestimate. Second, established clinical cutoffs for what is considered to be significant clinical disagreement between ratings of compliance measures does not exist. For example, it is not determined how much a participant can overreport compliance compared to computer-timed measures to be considered an invalid estimate of homework compliance. Lastly, given participants were aware that the researcher would be able to see how many mindfulness assignments were

submitted, the results may be biased, and may not generalize to other programs without this feature. Additionally, the sample was comprised of mostly female university students who received school credit for participating. Thus, the results may not extend to other populations. Future work should examine whether these results are consistent in more diverse community samples.

Future research with Internet-delivered interventions may wish to implement a similar computer-timed -measure of compliance to assess homework compliance. Conducting this research with other types of psychotherapeutic intervention may help to determine if compliance reporting is similar across interventions and populations. Furthermore, this unique computer-timed measure of compliance could be used to more accurately assess the assumption that mindfulness and/or the regular use of mindfulness exercises is the active ingredient in mindfulness-based therapies.

In conclusion, whether using retrospective or daily homework compliance, both had excellent reliability in the present study. The computer-timed measure used in this online program may be a more conservative, but accurate measure of homework compliance to the online mindfulness program that may reduce the likelihood of overestimation of homework compliance. This measure can be easily implemented into mindfulness interventions delivered online to determine compliance and to use compliance to predict outcomes.

Table 1. 1

Demographic Characteristics of Drop Out and Retained Participants

	Drop out		Retained			
Characteristic	*n*	%	*n*	%	*t* or χ^2	*p* value
Gender					$\chi^2 = 2.08$	.149
Female	6	100	32	86.5		
Male	0	0	5	13.5		
Ethnicity					$\chi^2 = 9.49$	.219
Black/ African American	0	0	1	2.7		
East Asian	1	16.7	2	5.4		
South Asian/Indian	0	0	2	5.4		
Hispanic/Latino	0	0	4	10.8		
Caucasian	4	66.7	20	54.1		
Arab/Middle Eastern	0	0	8	21.6		
Biracial	0	0	0	0		
Other	1	16.7	0	0		
English as first language					$\chi^2 = 7.34$	.007
Yes	4	66.7	32	86.5		
No*	2	33.3	5	13.5		
Relationship status					$\chi^2 = 1.49$	.685
Single	1	16.7	22	58.5		
In a relationship	4	66.7	11	29.7		
Married	0	0	2	5.4		
Cohabitating	1	16.7	2	5.4		

Employment					$\chi^2 = 1.74$	.187
Yes	4	66.7	22	59.5		
No	2	33.3	15	40.5		
Year of study					$\chi^2 = 9.36$	.053
1	1	16.7	7	18.9		
2	2	33.3	5	13.5		
3	0	0	13	35.1		
4	2	33.3	10	27.0		
5	1	16.7	2	5.4		
Grade					$\chi^2 = 1.27$	.737
<60%	0	0	1	2.7		
60-70%	1	16.7	9	24.3		
70-80%	4	66.7	16	43.2		
>80%	1	16.7	9	24.3		
Past therapy					$\chi^2 = 1.21$	.272
Yes	0	0	15	40.5		
No	6	100	22	59.5		
Previous diagnosis					$\chi^2 = 0.39$	.822
Yes	0	0	9	24.3		
No	6	100	27	73.0		
Prefer Not to Answer	0	0	1	12.7		
Brain injury**					$\chi^2 = 1.23$	.267

Yes	0	0	2	5.4		
No	6	100	35	94.6		
Neurological diagnosis					$\chi^2 = .17$	.679
Yes	0	0	1	2.7		
No	6	100	36	97.3		
Mindfulness experience					$\chi^2 = 2.87$	.581
No experience	2	33.3	15	40.5		
Highly variable	4	66.7	17	45.9		
<3times per week <6 mos	0	0	1	2.7		
<3 times per week >6 mos	0	0	1	2.7		
>4 times a week >6mos	0	0	3	8.1		

Note. *All spoke English conversationally >3 years; **No LOC or hospitalizations .

Table 1. 2

Descriptive Statistics of Measures of Compliance in Minutes

Compliance measure	Range	Mean	*SD*
Daily self-report	0-322	143.05	83.14
Retrospective self-report	5-360	127.24	79.23
Objective-computer-timed	0-298	100.05	71.43

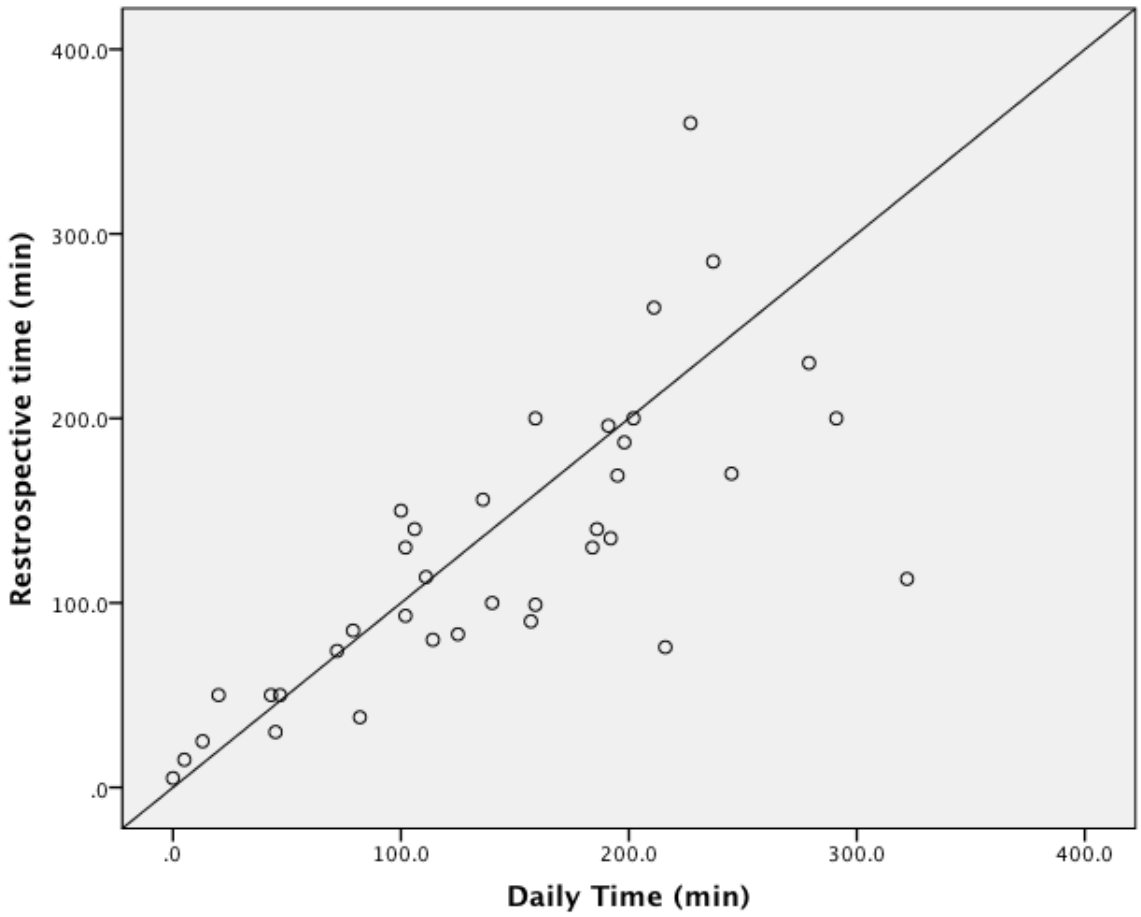

Figure 1. 1. Plot of identity (y = x) for retrospective and daily report of homework compliance.

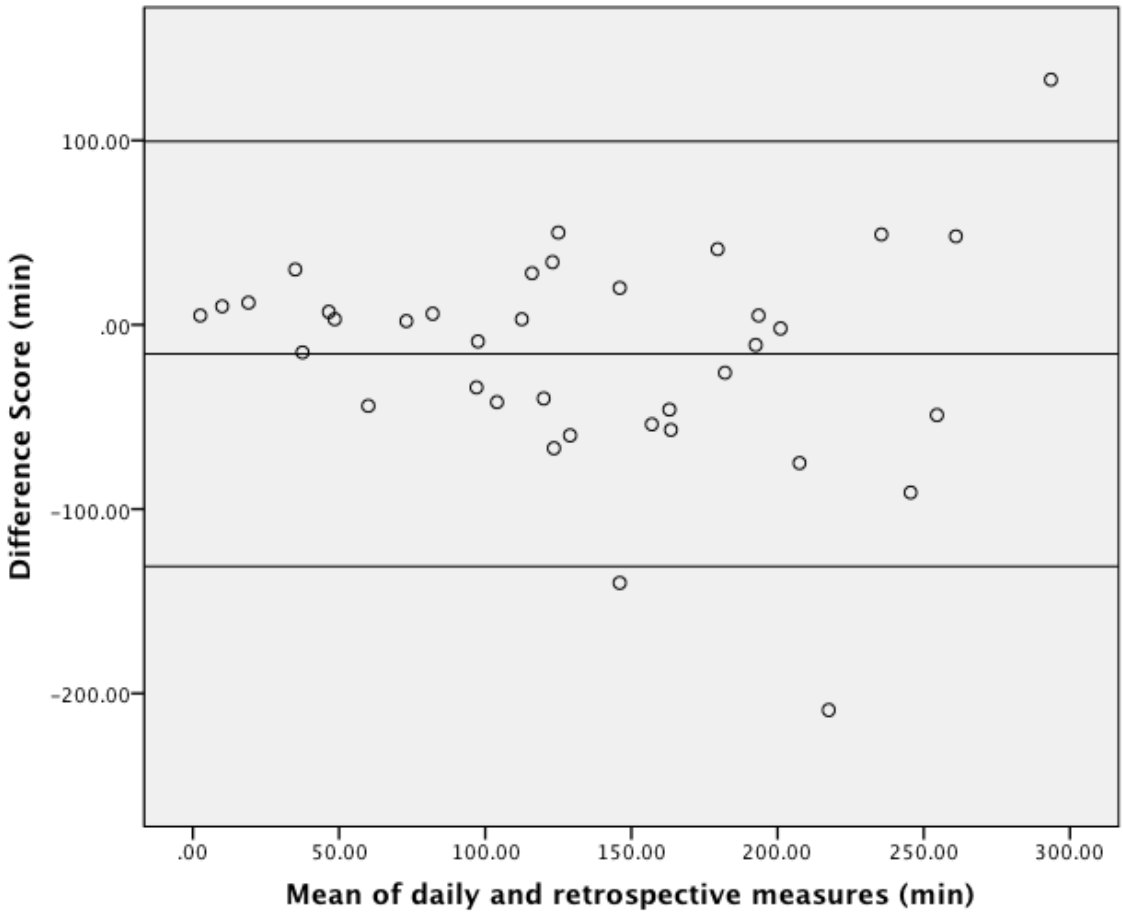

Figure 1. 2. Retrospective and daily report of homework compliance Bland-Altman plot.

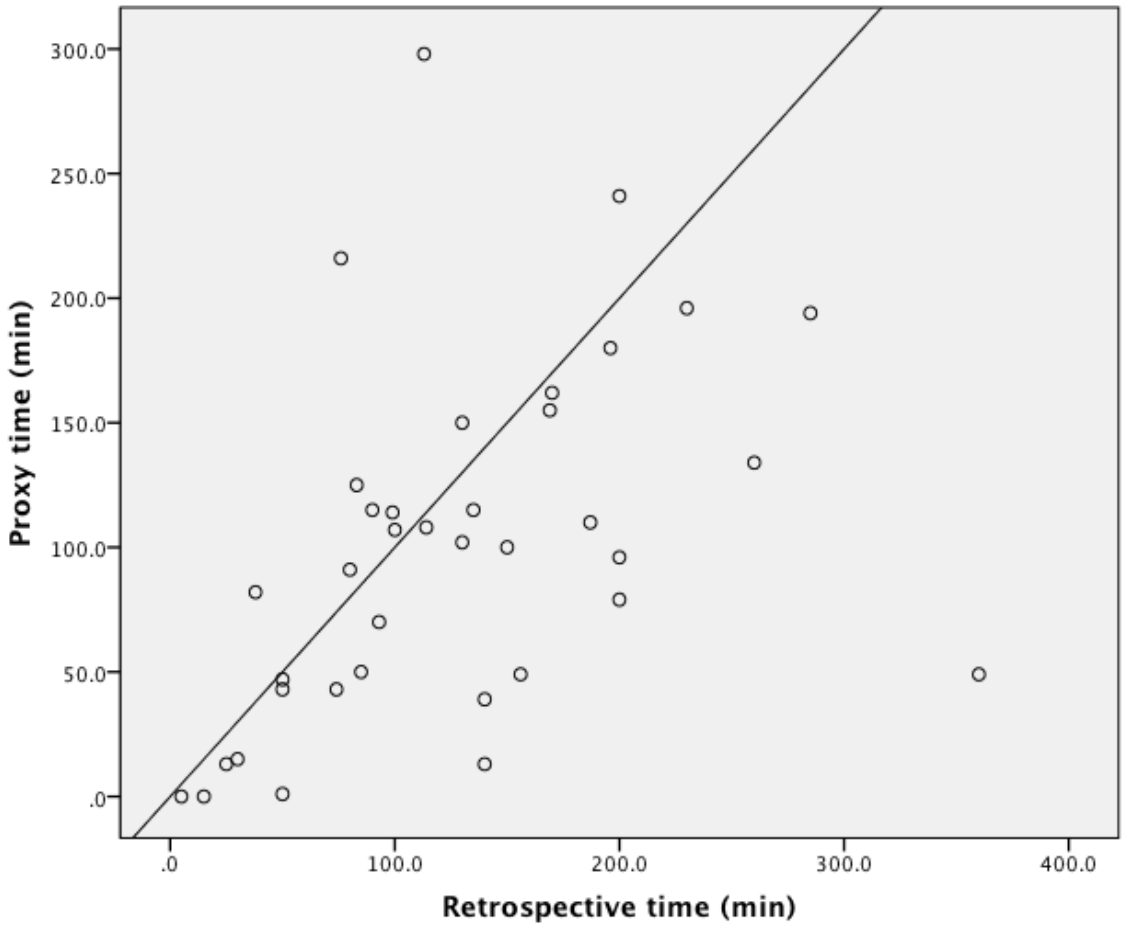

Figure 1. 3. Plot of identity (y = x) for computer-timed and retrospectively reported homework compliance.

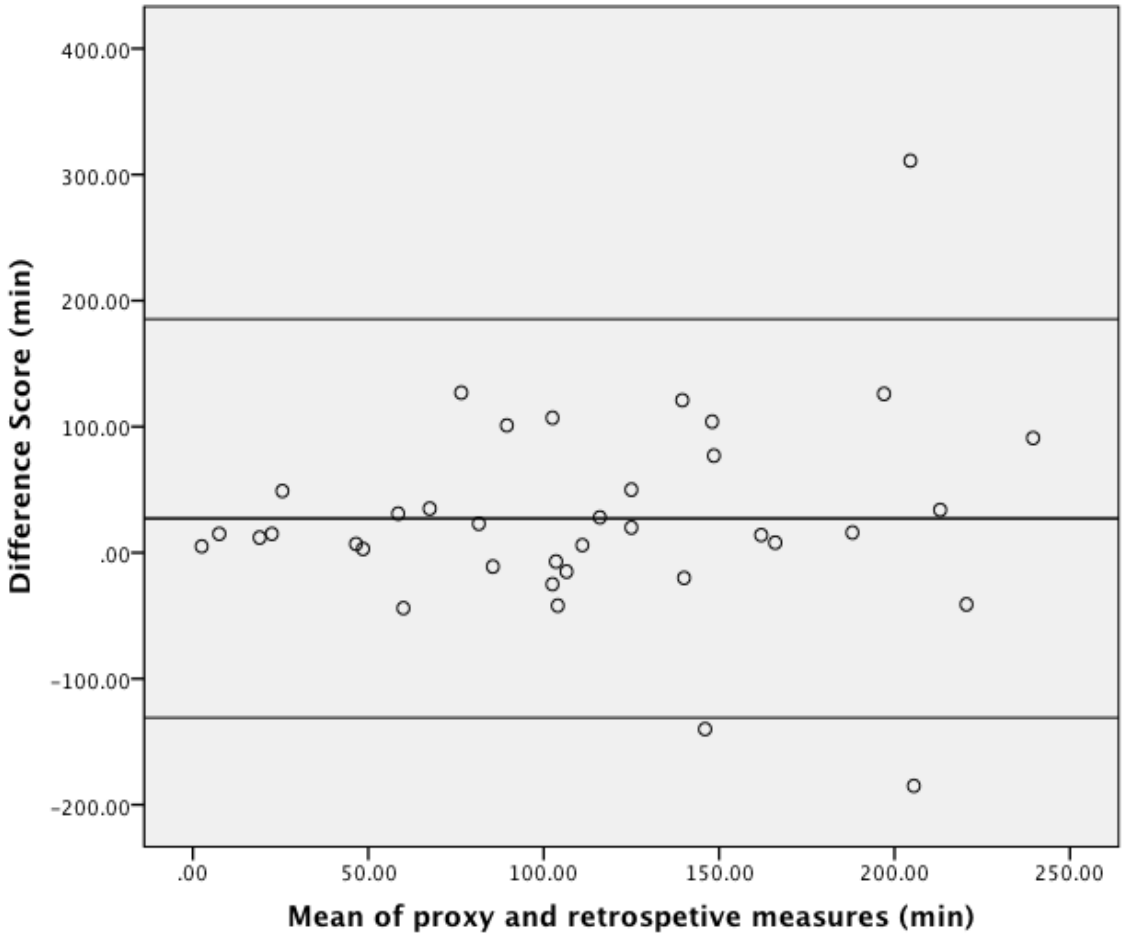

Figure 1. 4. Computer-timed and retrospectively reported homework compliance Bland-Altman plot.

CHAPTER 4

Study II: An investigation of factors that predict self-reported levels of mindfulness following an Internet-delivered mindfulness-based intervention

Regardless of therapeutic orientation, the assignment of therapeutic homework has been considered one of the most common clinical strategies used in psychotherapy (Kazdin & Mascitelli, 1982). Meta-analysis has demonstrated small to medium effect sizes between homework compliance and treatment outcomes across different symptom presentations, source of rating (i.e., therapist or client), and type of homework, indicating that better treatment compliance leads to better treatment outcomes overall (Mausback et al., 2010). Adherence to intervention and regular at-home practice is assumed to be an essential component of mindfulness-based interventions (MBIs) and the development of mindfulness skills (e.g., Carmody & Baer, 2008). Research investigating the impact of reported homework compliance on clinical outcomes in MBIs has been mixed; however, this could be due to inherent limitations of collecting compliance data. Compliance data are generally collected via self-report or clinician-report, either prospectively or retrospectively. This type of data raises concerns about reliability and validity of the measures used to assess compliance (Vettese et al., 2009), as self-report measures and retrospective measures of compliance can be significantly impacted by bias such as social desirability bias, recall bias, and the halo-effect (e.g., Kazantzis et al., 2004; Thase & Callan, 2006). Furthermore, research has shown that the association between homework compliance and outcomes is impacted by the source of the rating and timing of rating (Mausbach, 2010). For example, client self-reports have larger effect sizes compared to

therapist ratings and retrospective ratings have larger effect sizes than daily ratings (Mausbach, 2010).

Relationship between Homework Compliance and Mindfulness

Although evidence shows that self-reported levels of mindfulness in meditators and nonmeditators correlate with amount of meditation or mindfulness practice across many aspects of mindfulness (de Bruin, Topper, Muskens, Bogels, & Kamphuis, 2012), some aspects of mindfulness do not correlate with time spent practicing in the expected pattern (Lilja et al., 2013). In a study of 670 mediators and nonmeditators (n = 384 and n = 286, respectively), the type of practice (e.g., mindfulness, Zen, yoga), length of practice, frequency of practice, and lifetime practice length were examined to determine the association of practice with subjectively reported aspects of mindfulness (Soler et al., 2014). Overall, meditators reported higher levels of mindfulness than nonmeditators. Three factors on the Five Facet Mindfulness Questionnaire (FFMQ) – Observing, Non-reactivity, and Decentering – best differentiated between the meditators and nonmeditators and were most closely associated with the reported frequency of meditation and length of total meditation practice across the lifespan (Soler et al., 2014). The actual duration of each single meditation session was only related to the factor Observing, which might suggest that length of meditation session is less important for the development of other mindfulness factors in experienced meditators. However, Observing is considered an essential component to mindfulness, so this does not suggest length of meditation is not an important factor to consider. This research was conducted on individuals who were meditators prior to study and not in the context of an MBI.

Thus, meditation length in the context of homework in novice meditators may be more important or more closely related to changes in mindfulness.

In studies investigating the link between mindfulness practice and self-reported levels of mindfulness within the context of an MBI, findings have been mixed. A review of the literature found 24 studies that examined the association between at home practice and clinical outcome measures in MBIs (Vettese et al., 2009); however, only three studies investigated the relationship between home practice and changes in mindfulness, specifically. Two of the three studies found a relationship between time spent practicing and changes on measures of mindfulness (Carmody & Baer, 2008; Schenström, Ronnberg, & Bodlund, 2006). Since the publication of that review, several studies have investigated the association of between-session practice and various outcomes, including changes in mindfulness. For example, an investigation of an 8-week MBSR course on affective and cognitive processes in a sample of individuals with mood and anxiety disorders demonstrated that amount of meditation practice predicted reduced ruminative cognitions, but did not predict reductions in depressive or anxious symptoms (Ramel, Goldin, Carmona, & McQuaid, 2004). Moreover, in a study of 174 adults with a wide range of problems (e.g., illness, personal or employment-related stress, chronic pain, anxiety) enrolled in an MBSR group, increases in self-reported mindfulness skills fully mediated the relations between time spent practicing and decreases in psychological symptoms and stress, and partially mediated the relation between time spent practicing skills and improved well-being (Carmody & Baer, 2008), again demonstrating the relation between time spent practicing and psychological outcomes. Contrary, research has shown that after accounting for age and baseline mindfulness scores on the FFMQ the

frequency and duration of self-reported practice does not predict postintervention scores on the FFMQ following an 8-week Mindfulness-based Relapse Prevention for community-based adults in a substance abuse treatment program (Manuel, Somohano, & Bowen, 2017). These findings suggest that time spent practicing may impact changes in psychological outcomes and changes in self-reported mindfulness differently.

The mixed findings regarding the association between self-reported levels of mindfulness and other outcomes, and between-session practice could be related to several issues. First, the research is quite heterogeneous; it has been conducted within and outside of the context of MBIs, in meditators and nonmeditators, and with various clinical and nonclinical populations. This could suggest that differences between mindfulness and treatment outcomes, including postintervention mindfulness scores, may differ among these groups (Bowen & Enkema, 2014). Mixed findings could also be related to the aforementioned difficulties of measuring compliance to between-session homework, such as concerns about reliability and validity of measures and bias with commonly used retrospective and daily self-reported measures of homework compliance. Given the recent emergence of Internet-delivered interventions, this presents a unique opportunity to collect compliance data more objectively by tracking program activity of the users. However, within the literature of Internet-delivered interventions, there has similarly been little emphasis on how obtaining these computer-timed measures of homework compliance may improve studies on compliance and outcomes.

Compliance to Internet-Delivered Interventions

A review of Internet-delivered psychological interventions found that the assessment of compliance varied widely across studies, including number of logins,

completed modules/activities, visits to forums, posts to forums, pages viewed/printed, and self-reported completion of activities offline (Donkin et al., 2011). Despite the ease of being able to capture participant logins, only half of the studies included in the review presented logins as a measure of adherence (n = 33 of 69). The number of modules completed was the next most commonly used measure of adherence (n = 16). The number of modules completed correlated with psychological outcomes (e.g., depression/anxiety disorder), whereas other reported measures of adherence (i.e., logins, times spent online) did not correlate with outcome in studies of depression and anxiety (Donkin et al., 2011). Given that time spent practicing mindfulness is assumed essential to improvement and development of mindfulness skills, it is proposed that measures such as time spent listening to the audio recordings will be associated with increased mindfulness.

Although these data can be collected relatively easily in online interventions, it has not routinely been collected or studied. Research investigating Internet-delivered mindfulness-based interventions (ID-MBIs) and homework compliance have similar methodological limitations. For example, the use of self-reported completion of homework is widely implemented across ID-MBIs to assess compliance (e.g., Cavanagh et al., 2013). However, the use of the Internet as a platform to provide treatment provides a unique possibility to investigate individual participant usage data to determine compliance to assigned mindfulness activities and how that impacts changes in mindfulness following the intervention.

Compliance to Internet-Delivered Mindfulness-Based Interventions

In the last several years, researchers have begun to make use of this unique feature. For example, Mak et al. (2015) tracked use of a mindfulness program via unique login ID, but only reported that there were no significant differences between the number of days participants spent on the website between the groups. Another study of Internet-delivered mindfulness required participants to click on a link that would appear after completing the assigned audio exercises to assess compliance. Participants were unable to fast-forward to the end of the track and if the link was not clicked within five minutes of completion of the exercise it disappeared (Messer et al., 2016). The researchers, however, did not report these compliance data. Although useful data have been collected, none of the aforementioned studies have reported data on total time spent practicing. Although researchers have assessed feasibility and usage via number of logins and login time, this is not indicative of actual practice time. No previous studies of ID-MBIs have compared usage data to self-reported changes in mindfulness to determine if this computer-timed measure of compliance more accurately captures changes in self-reported mindfulness following intervention. If this computer-timed measure of compliance predicts changes in mindfulness and the predicted group differences emerge (i.e., participants who practice more report higher levels of mindfulness postintervention) this would support the assertion that consistent practice is an essential component to MBIs and provide support for the assumption that mindfulness is an important mechanism of change within MBIs.

Individual Difference Factors and Mindfulness

Changes in mindfulness are the most well-supported mechanism of change within MBIs (Gu et al., 2015); therefore, investigating the individual difference factors that may predict changes in mindfulness and that are likely related to compliance is essential.

Personality factors are likely to be related to changes in mindfulness post-MBI given that mindfulness has been shown to correlate with the 'Big Five' personality traits: neuroticism, extroversion, openness to experience, agreeableness, and conscientiousness (Giluk, 2009). For example, mindfulness has been shown to be inversely associated with neuroticism (Baer et al., 2006), positively associated with conscientiousness (Giluk, 2009), and has moderate association with extraversion, agreeableness, and openness to experience (Brown & Ryan, 2003). A small number of studies have assessed the relationships between personality traits and MBI outcomes. Feltman and colleagues (2009) found that individuals with higher levels of neuroticism reported lower levels of anger and depression following a MBI compared to individuals lower on neuroticism. It has also been shown that individuals with higher levels of neuroticism and conscientiousness had better outcomes on well-being and stress, respectively, than those low on the personality traits (de Vibe et al., 2015). Overall, individual difference factors that predict improvements in mindfulness following MBIs have had little emphasis in traditional MBI literature, and no research support within ID-MBIs. To date, no studies of Internet-delivered mindfulness interventions have examined individual difference factors that might impact outcomes. However, this is important research to conduct at this time, given the recent surge of interest in providing MBIs online. Investigating individual difference factors that predict better outcomes may help to determine if individuals with particular personality traits benefit more from this online mindfulness intervention.

Study Aims and Hypothesis

As previously mentioned, practicing mindfulness is considered an essential component to developing mindfulness skills, and the most well-studied mechanism of

change in MBIs (Gu et al., 2015). The current study was intended to investigate these issues by examining if the computer-timed measure of time spent practicing mindfulness and personality factors predict postintervention levels of mindfulness. By reducing the bias common to self-report measures of compliance, I sought to assess a more accurate analysis of the impact of mindfulness practice on mindfulness skill development. Furthermore, there is limited research on personality factors that impact outcome after MBIs and no studies have examined personality factors that might predict success of ID-MBI. This could be particularly important for Internet-delivered interventions because they may not be appropriate for everyone. The study sought to determine if certain characteristics, such as conscientiousness and neuroticism, made people more likely to benefit from the ID-MBI. Conscientiousness and neuroticism were included in this analysis because research suggests these two personality factors have the strongest associations with mindfulness (Baer et al., 2006; Giluk, 2009),.

Study aims. This study first aimed to determine if group membership and personality factors predict changes in self-reported mindfulness following the 4-week Internet-delivered mindfulness-based intervention. Additionally, if group membership predicted postintervention mindfulness, the study aimed to further clarify if time spent practicing mindfulness predicted postintervention mindfulness for the participants who were assigned to the intervention group, using the computer-timed measure of mindfulness practice.

Hypothesis 1. Group membership (mindfulness vs. control) would predict mindfulness postintervention above and beyond relevant demographic and personality variables.

Hypothesis 2. If group membership was a significant predictor of postintervention mindfulness in the total sample (hypothesis 1), then increased time spent adhering to mindfulness exercises would predict postintervention mindfulness in the intervention group.

Hypothesis 3. Personality factors would predict mindfulness postintervention in the intervention group above and beyond time spent practicing. Specifically, higher scores on conscientiousness and higher scores on neuroticism will predict higher levels of self-reported mindfulness postintervention.

Methods

Participants

I conducted a priori power analyses using the program G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007). To determine the required sample size for a multiple regression analyses with four independent variables, a power of .80, alpha value of .05, and a medium effect size were specified. A sample size of 70 participants was identified. Additionally, post-hoc power analyses were conducted. With the observed large effect size for both regression analyses ($f^2 > 0.35$; Cohen, 1988), the required sample size for a multiple regression analyses with four independent variables, a power of .80, alpha value of .05, a sample size of 39 participants was determined to be required.

Participants ($N = 84$, female $n = 74$) ages 17-49 years old ($M = 21.39$, $SD = 4.06$) were enrolled from the University of Windsor's psychology department participant pool from September 2017 to July 2018. The retained group ($N = 71$, female $n = 61$) ranged in age from 17 to 49 years old ($M = 21.28$, $SD = 4.16$). Participants identified as 56.3% Caucasian, 19.7% Arabic/Middle Eastern, 7.0% South Asian/Indian, 5.6% Hispanic,

4.2% Black/African American, 4.2% Biracial, and 2.8% East Asian. Participants ranged from first to fifth year students (21.2% in first year, 15.5% in second year, 32.4% in third year, 25.4% in fourth year, and 4.2% in fifth year). The majority reported no prior meditation experience (53.5%; see Table 1 for demographic variables).

Participants lost to attrition ($N = 13$) were all female and ranged in age from 18 to 30 years old ($M = 22.00$, $SD = 3.46$). They identified as 46.2% Caucasian, 15.4% South Asian/Indian, 7.7% Arabic/Middle Eastern, 7.7 % East Asian, 7.7% as Black/African American, and 7.7% biracial. The drop out participants ranged from first to fifth year students (15.4% in first year, 30.8% in second year, 7.7% third year, 23.1% fourth year, and 23.1% fifth year). The majority reported either highly variable experience with meditation (46.2%) or no prior meditation experience (30.8%); see Table 1 for demographic variables.

T-test and chi-square tests were used to analyze group differences on demographic and preintervention variables (e.g., mindfulness, perceived stress, and psychological symptoms) between the attrition group and retained group. Bivariate analyses conducted to determine differences between the attrition and retained groups demonstrated that participants in the drop-out group were more heavily represented by participants who identified English as a second language, $\chi^2 (1) = 7.34$, $p < .001$. The groups did not differ significantly on any other demographic variables ($p > .05$) or any other preintervention variables such as mindfulness or emotional distress ($p > .05$; see Table 1).

T-test and chi-square tests were used to analyze group differences on demographic and preintervention variables (e.g., mindfulness, perceived stress, and

psychological symptoms) between the intervention and waitlist group to determine if there were any significant preintervention differences. Bivariate analyses demonstrated that the groups did not differ significantly on any demographic variables ($p > .05$). With regard to other preintervention variables, there were no significant differences between the groups ($p > .05$). See Table 2.

Procedures

Participants were recruited through the departmental research participant pool. Participants who met eligibility criteria were randomly assigned to the mindfulness intervention or waitlist-control condition upon arrival for the preintervention assessment. Following completion of the intervention, participants in the waitlist group were offered the programming. See Chapter 2 for detailed procedures. All procedures were approved by the University of Windsor Research Ethics Board.

Measures

Demographics. Participants completed a demographic questionnaire at baseline that included questions regarding age, sex, ethnicity, years of education, language, and mindfulness/meditation experience,(see Appendix B). These data were used to describe the sample. Furthermore, if outliers or influential observations were noted, then these demographics variables might partially explain the mechanism of effect. For example, individuals who report English as a second language and poor conversational English may not benefit from the audio exercises as much as their English-speaking peers.

Computer-timed compliance. I created a novel computer-timed measure of compliance with the intervention by calculating the participant's activity with each module. Each participant was assigned a unique ID and password to access the

intervention online. The participant's completion of mindfulness assignments was determined via their ID. When participants started and submitted their mindfulness exercises, an email was sent from the program with a time-stamp. I used this to determine how long the audio-recorded mindfulness activities were used (i.e., from the time the exercises was started and stopped) and how many days the participant used the audio recorded interventions to practice their mindfulness skills. The time spent listening to the audio-recorded mindfulness exercises was calculated by subtracting the time the assignment was submitted from the time the assignment was started. If the time exceeded five minutes beyond the length of the exercise (e.g., a 5-minute exercise started at 3:00 p.m. and submitted at 3:30 p.m.), then it was considered to be an incomplete exercise, and scored as 0 minutes spent practicing. If the time did not exceed five minutes beyond the length of the exercises (e.g., a 5-minute exercise started at 3:00 p.m. and submitted at 3:06 p.m.), then it was considered a complete exercise and a score of 5-minutes spent practicing (the length of the exercise) was assigned to the participant for that day. Thus, as long as the assignment was submitted within five minutes after the audio was completed, the length of that exercise would be considered the computer-timed practice time. However, if the participant opened the exercise and submitted before the exercise would be completed (e.g., a 5-minute exercise started at 3:00 p.m. and submitted at 3:02 p.m.), then the time it was opened was considered the practice time, in this case 2 minutes. The total time in minutes across the four weeks was used as the computer-timed measure of compliance in the following analyses. Given the nature of this measure, in some cases the computer-timed and subjective report of compliance were identical. For example, if a participant started a 5-minute exercise at 3:00 p.m., submitted it at 3:06

p.m., and reported practicing for 5-minutes, then both the subjective and computer-timed measure of compliance for that data point would be 5-minutes.

Personality. The Big Five Inventory (BFI; John, Donahue, & Kentle, 1991) was used to assess personality, which assesses five personality dimensions: Extraversion (8 items), Agreeableness (9 items), Conscientiousness (9 items), Neuroticism (8 items), and Openness (10 items). The BFI contains 44-items that are measured on a 5-point Likert scale ranging from 1 (*Disagree Strongly*) to 5 (*Agree Strongly*). Research has shown these five dimensions to be robust across different languages and cultures (McCrae & Costa, 1997). The BFI scales have demonstrated alpha reliabilities ranging from .75 to .90 and good test-retest reliability in normative sampling (John et al., 2008). Only the subscales of conscientiousness and neuroticism, which are sums of the item scores, were used in the current analysis. In the current analysis, both scales demonstrated good internal consistency (see Table 3).

Mindfulness. The Five Facet Mindfulness Questionnaires (FFMQ; Baer et al., 2006) was used to assess mindfulness at pre- and postintervention. I used a trait measure of mindfulness in order to determine if the intervention increases dispositional mindfulness through increases in state mindfulness by practice across the four-week intervention. The FFMQ is a 39-item self-report measure. Items are rated on a 5-point Likert scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*). The scale consists of five factors: Observing, Describing, Acting with Awareness, Nonjudging, and Nonreactivity. However, as recommended, only four factors (Describing, Acting with Awareness, Nonjudging, and Nonreactivity) were used in the total (i.e., sum) score in the current study to measure pre- and postmindfulness scores (Gu

et al., 2016) due to differences found in the factor structure for nonmeditators and meditators. Factor analysis has demonstrated that a four-factor model (without the Observing scale) provides the best fit for individuals with little or no meditation experience (Baer et al., 2006; Gu et al., 2016). It is suggested that this four-factor model has better fit among nonmeditators because Observing has a nonsignificant relation to Nonjudging and Acting with Awareness in individuals with little or no meditation experience (Baer et al., 2006, Curtiss & Klemanski, 2014). Thus, in nonmeditators, the Observing scale may reflect attention to experiences in a neutral or negative way (e.g., anxious monitoring of experience), and not the participant's abilities to observe experiences mindfully in a curious and nonjudgmental manner (Gu et al., 2016). For this reason, a total FFMQ score containing the four factors, Describing, Acting with Awareness, Nonjudging, and Nonreactivity, has been recommended as a more accurate measure of mindfulness in individuals with little to no formal meditation experiences, such as students. The FFMQ has demonstrated good internal consistency and has been validated for use in college sample (Baer et al., 2006a, 2006b, 2008), and validated in individuals with little to no meditation experience (Baer et al., 2006; Gu et al., 2016). The dependent variable in the current study was the four-factor total FFMQ at postintervention. The preintervention FFMQ total score was used as a control in the regression analyses. In the current analysis, the scale demonstrated good internal consistency at pre- and postintervention (see Table 3).

Data Analysis

Preliminary analyses. Prior to conducting the primary analyses, I tested the assumptions of regression analyses. This included independence of observations (e.g.,

Durbin-Watson statistic), normality of variables (e.g., histograms, boxplots), linear relationship between independent and dependent variables (e.g., scatter plots), absence of multicollinearity (e.g., correlation coefficients, VIF/Tolerance values), homoscedasticity (e.g., scatterplot), and absence of outliers (e.g., Cook's distance). In the case that assumptions were violated, the data were cleaned and transformed. I examined missing data by conducting a missing value analysis. The method of handling the missing data was selected based on results of this analysis. Correlation analyses were conducted to identify potential covariates and explore the associations between mindfulness, time spent practicing (i.e., number of minutes), and the Big Five personality factors, prior to conducting the primary analyses.

Primary analysis. A proposed multiple regression was conducted. The factors that were entered into the regression equation were group membership (i.e., Mindfulness or waitlist) and individual differences in personality factors (i.e., neuroticism and conscientiousness). Given that group membership predicted the outcome, the regression using the computer-timed measure of compliance (i.e., time spent practicing) was conducted to determine if the computer-timed measure of compliance and individual differences in personality factors (i.e., neuroticism and conscientiousness) predicted outcomes for participants in the mindfulness intervention group. The purpose of the regression was to determine if personality variables predicted success of the intervention over and above actual time spent practicing.

Results

Missing data were a result of item nonresponse, in which subjects did not provide information for some items. Given data were missing completely at random (MCAR; χ^2

(122) = 0.0, p >.05) and the percentage of missing data is low (<0.0001%), procedures outlined in each respective measure were used to prorate the scale for participants with missing items.

Preliminary Analysis

There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.21. With regard to linearity, partial regression plots indicated a linear relationship between the dependent variable and each of independent variables. The assumption of homoscedasticity is that the residuals are equal for all values of the predicted dependent variable. There was homoscedasticity as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. Multicolinearity as assessed by VIF was not violated. All VIF scores were <10. With regard to outliers, there were no studentized residuals greater than ±3. Influential points and outliers were assessed using leverage points and Cook's distance. There were six leverage points greater than the conventional cut off of 0.2, however none of these points had Cook's distance values above 1 (Cook & Weisberg, 1982). Normality as assessed by Q-Q plots and histograms of residuals revealed adequate normality.

Primary Analysis

A multiple regression was performed to determine the effects of group membership (coded as 1 = mindfulness, 2 = waitlist group), neuroticism, and conscientiousness on postintervention mindfulness (see Table 4 for intercorrelations of variables). Preintervention levels of mindfulness were also included in the regression as a control. The regression model was statistically significant, $F(4,66) = 25.587$, $p < .001$. R^2 for the overall model was 60.8% with an adjusted R^2 of 58.4%, a large size effect

according to Cohen (1988). Group membership (B = -7.977, SE = 2.754, t = -2.897, p = .005), neuroticism (B = -0.604, SE = 0.279, t = -2.168, p = .034), and preintervention mindfulness (B = 0.505, SE = 0.110, t = 4.611, p <.001) were significant predictors of postintervention mindfulness (see Table 5 for group means, see Table 6 for regression model). Thus, the predicted postintervention mindfulness score for the waitlist group was 8 points lower than that predicted for the mindfulness group, with all values of all other independent variables being held constant. This was consistent with hypothesis 1, which predicted that group membership, specifically being in the mindfulness group, would predict higher postintervention mindfulness, above and beyond relevant personality factors. Interestingly, the predicted postintervention mindfulness score was 0.6 points higher for every one point decrease on neuroticism at preintervention and 0.5 higher for every one point higher on preintervention mindfulness.

Given that group membership predicted postintervention mindfulness, a multiple regression was performed to determine the effects of time spent practicing mindfulness, neuroticism, and conscientiousness on postintervention mindfulness in the intervention group (see Table 6 for intercorrelations of the variables). Preintervention levels of mindfulness were also included in the regression as a control. The regression model was statistically significant, F(4,32) = 10.42, p < .001. R^2 for the overall model was 56.6% with an adjusted R^2 of 51.1%, a large size effect according to Cohen (1988). Contrary to hypothesis 2, time spent practicing (B = 0.003, SE = 0.03, t = 0.106, p = .916) was not a significant predictor of postintervention mindfulness. Conscientiousness (B = 1.18, SE = .416, t = 2.835, p =.008) was the only significant predictor of postintervention mindfulness after controlling for preintervention mindfulness (see Table 5 for group

means, see Table 7 for regression model), providing partial support for hypothesis 3. Additionally, the regression was conducted with both the daily self-reported and retrospectively reported compliance measures. Neither measure of compliance predicted postintervention mindfulness and the regression results remained stable, with conscientiousness being the only significant predictor of postintervention mindfulness.

Post Hoc Analysis

Given that conscientiousness was predictive of postintervention levels of mindfulness, a post-hoc analysis was conducted to examine whether conscientiousness was related to participant engagement (i.e. did participants with lower conscientiousness require more email reminders to practice?). Overall, the number of reminders sent to participants ranged from 2 to 6 (M = 3.95, mode = 3.00). With regard to the dropout group, the number of reminders sent ranged from 2 to 5 (M = 3.50 mode = 3.00). There was no significant relation between conscientiousness and number of emails sent to participants (r = -.142, p > .05).

Discussion

This was the first known study to investigate if compliance with at-home practice, using a novel computer-timed measure of time-sent practicing mindfulness, predicted postintervention levels of mindfulness following an ID-MBI. Additionally, it is the first study to assess if certain personality traits make people more likely to benefit from an ID-MBI. Group membership (i.e., waitlist vs. MBI) was the strongest predictor of postintervention levels of mindfulness in the total sample. As predicted, individuals in the mindfulness group reported higher levels of mindfulness following the intervention than the waitlist group, which was expected given that the waitlist group did not receive the

mindfulness program. This indicates that the intervention likely increased mindfulness, even when controlling for the participants preintervention levels of mindfulness. This is important given that mindfulness practice is considered an essential component to developing mindfulness skills; thus, group membership predicting postintervention mindfulness suggests that some component of the intervention helped to improve mindfulness skills over the four weeks.

Lower levels of neuroticism and higher preintervention mindfulness also predicted higher levels of postintervention mindfulness, regardless of group membership. With regard to neuroticism, participants with lower levels of neuroticism reported higher levels of mindfulness, regardless of group membership. Individuals who report higher levels of neuroticism are more likely than average to experience psychopathology and emotional distress (e.g., worry, anxiety, fear), suggesting that individuals with lower levels of psychopathology and negative distress may report increases in mindfulness from this online program. Therefore, less neurotic individuals with less severe psychopathology may benefit more from this program. Surprisingly, individuals in the waitlist group who were less neurotic also reported higher levels of mindfulness postintervention. Thus, by simply being introduced to the concept of mindfulness (i.e., participants in the waitlist control condition), individuals with less neuroticism reported higher mindfulness. Additionally, preintervention levels of mindfulness were related to greater increases in mindfulness at postintervention while holding group membership constant. This suggests that individuals who identify as having higher trait mindfulness may benefit more from online mindfulness programming than individuals with lower levels of mindfulness, but again, being exposed to mindfulness (i.e. being in the waitlist

control condition) may have impacted postintervention reports for individuals higher on trait mindfulness at preintervention. It is hypothesized that this finding could be related to the participant's awareness of the studies focus on mindfulness (e.g., Hawthrone effect), or it could be that participants who are less neurotic and more mindful may have done their own research/practice of mindfulness after being assigned to the waitlist control condition. Future work may wish to ask about independent mindfulness psychoeducation or practice in the waitlist control condition to clarify these findings.

Although group membership did predict outcomes in the total sample, in the regression that examined predictors of postintervention mindfulness looking at only the group who received the intervention, the actual time spent practicing mindfulness did not predict outcomes. The computer-timed measure of compliance was used to more accurately capture self-reported mindfulness practice. By reducing the bias common to self-report measures of compliance, the study intended to conduct a more accurate analysis of the impact of actual mindfulness practice on mindfulness skill development, an assumed essential component of MBIs. Time spent practicing did not significantly predict postintervention mindfulness. Thus contrary to what was predicted, raw time spent using guided exercises was not the best predictor of outcome, and perhaps not the active ingredient leading to changes in this mindfulness program. In studies investigating the link between mindfulness practice and self-reported levels of mindfulness within the context of a MBI, findings have been mixed (Vetesse et al., 2009). It may be that other factors, such as quality of practice, are more important than amount of time spent practicing to mindfulness outcomes (Del Re, Fluckiger, Golderberg, & Hoyt, 2013). In line with hypothesis 3, conscientiousness was the only significant predictor of

postintervention mindfulness in the intervention group, suggesting that individuals in the mindfulness group with higher trait conscientiousness reported higher mindfulness following the intervention. This is consistent with some previous work that has shown individuals with higher levels of conscientiousness had better outcomes following a MBI (de Vibe et al., 2015). Conscientiousness may have been a better predictor of postintervention mindfulness than time spent practicing because those with higher conscientiousness engaged with the psychoeducation material more, did exercises and activities more carefully, or applied the techniques to day-to-day life (i.e., informal practice) more than those who were less conscientious, which could have led to greater quality in practice. Some research suggests better quality of practice may lead to better outcomes above raw time spent practicing (del Re, Flückiger, Goldberg, & Hoyt, 2013).

Neuroticism was not related to outcomes in the intervention group as hypothesized. This is somewhat inconsistent with previous work that has found individuals with higher levels of neuroticism report better outcomes following an MBI, such as lower levels of anger and depression (Feltman et al., 2009) and stress (de Vibe et al., 2015) and improved well-being (de Vibe et al., 2015). Perhaps, the association of mindfulness and neuroticism during an online intervention was different than that which has been previously found for its relation to outcomes in traditional in-person mindfulness programs. It is also possible that these personality factors may have different associations with different outcomes measures (i.e., mindfulness vs. psychological symptoms). Furthermore, it could be that the relatively smaller sample size in the regression predicting outcomes for just the intervention group may have led to lower statistical power.

The findings demonstrated several important clinical implications. Participants benefited from the program even though they were not required to practice for 45-minutes a day – a common expectation in traditional in-person mindfulness programs. Additionally, individuals with higher conscientiousness reported higher levels mindfulness postintervention. This finding provides critical information about who this programs may be most beneficial for. It was found that regardless of group, individuals with lower neuroticism and higher mindfulness reported improved mindfulness after the 4–weeks. This association may not have been found in the second regression due to smaller sample size and less statistical power. It would be worthwhile for future work to investigate this association further, as it may be that individuals with less severe psychopathology and higher trait mindfulness may benefit more from this self-guided program.

Limitations of this study include a small sample size and a primarily female sample. Future work would benefit from including more diverse populations, to determine if these effects are consistent across settings (e.g., community samples). Additional research should be conducted to further clarify the relationship between actual time spent practicing mindfulness and intervention outcomes by assessing other factors that may be important to outcomes such as quality of practice or informal practices that were not recorded in the current investigation. Further research is necessary to clarify whether certain characteristics may make people more likely to benefit from the ID-MBI, such as lower levels of neuroticism, and how those personality characteristics might impact different outcomes, such as psychological outcomes or general well-being.

Table 2. 1

Demographic Characteristics of Drop Out and Retained Participants

	Drop out		Retained			
Characteristic	*n*	%	*n*	%	χ^2	*p* value
Gender					$\chi^2 = 2.078$	.149
Female	13	100	61	85.9		
Male	0	0	10	14.1		
Ethnicity					$\chi^2 = 9.50$	.219
Black/ African American	1	7.7	3	4.2		
East Asian	1	7.7	2	2.8		
South Asian/Indian	2	15.4	5	7.0		
Hispanic/Latino	0	0	4	5.6		
Caucasian	6	46.2	40	56.3		
Arab/Middle Eastern	1	7.7	14	19.7		
Biracial	1	7.7	3	4.2		
Other	1	7.7	0	0		
English as first language					$\chi^2 = 7.341$	.007
Yes	8	61.5	64	90.1		
No	5*	38.5	7**	9.9		
Relationship Status					$\chi^2 = 1.49$	.685
Single	6	46.2	40	56.3		
In a relationship	6	46.2	27	38.0		
Married	0	0	2	2.8		
Cohabitating	1	7.7	2	2.8		

Employment					$\chi^2 = 1.744$	.187
Yes	11	84.6	47	66.2		
No	2	15.4	24	33.8		
Year of Study					$\chi^2 = 9.36$	.053
1	2	15.4	15	21.1		
2	4	30.8	11	15.5		
3	1	7.7	23	32.4		
4	3	23.1	18	25.4		
5	3	23.1	3	4.2		
Grade					$\chi^2 = 1.27$	.737
<60%	0	0	2	2.8		
60-70%	4	30.8	18	25.4		
70-80%	6	46.2	29	40.8		
>80%	2	15.4	20	28.2		
Past Therapy***					$\chi^2 = 1.21$	.272
Yes	2	15.4	23	32.4		
No	10	76.9	48	67.6		
Previous Diagnosis***					$\chi^2 = 0.39$	.822
Yes	2	15.4	13	18.3		
No	10	79.6	55	77.5		
Prefer Not to Answer	0	0	2	2.8		
Brain Injury***					$\chi^2 = .1.23$	.267

Yes****	2	15.4	5	7.0		
No	10	76.9	66	93.0		
Neurological Diagnosis***					$\chi^2 = 0.17$	.679
Yes	0	0	1	1.4		
No	12	92.3	70	98.6		
Mindfulness Experience***					$\chi^2 = 2.87$	.581
No experience	4	30.8	38	53.5		
Highly Variable	5	46.2	26	36.6		
<3times per week <6 mos	1	7.7	2	2.8		
>3 times per week <6 mos	0	0	0	0		
<3 times per week >6 mos	0	0	2	1.6		
>3 times a week >6mos	1	7.7	3	4.2		

Note. * All spoke English conversationally >3 years, **One respondent did not answer in drop out group. *** Six spoke conversational English for >3 years, 1 for 1-3 years, **** One respondent did not answer in retained group.

Table 2. 2

Demographic Characteristics of Intervention and Waitlist Participants

	MBI		Waitlist			
Characteristic	*n*	%	*n*	%	t or χ^2	*p* value
Gender					$\chi^2 = 0.21$	.885
Female	32	86.5	29	85.3		
Male	5	13.5	5	14.7		
Ethnicity					$\chi^2 = 9.71$	.137
Black/ African American	1	2.7	2	5.9		
East Asian	2	5.4	0	0		
South Asian/Indian	2	5.4	3	8.8		
Hispanic/Latino	4	10.8	0	0		
Caucasian	20	54.1	20	58.5		
Arab/Middle Eastern	8	21.6	6	17.6		
Biracial	0	0	3	8.8		
Other	0	0	0	0		
English as first language					$\chi^2 = 1.16$	.281
Yes	32	86.5	32	94.1		
No	5*	13.5	2**	5.9		
Relationship Status					$\chi^2 = 5.21$	.157
Single	22	58.5	18	52.9		
In a relationship	11	29.7	16	47,1		
Married	2	5.4	0	0		
Cohabitating	2	5.4	0	0		

Employment					$\chi^2 = 1.57$	.211
Yes	22	59.5	25	73.5		
No	15	40.5	9	26.5		
Year of Study					$\chi^2 = .879$	.928
1	7	18.9	8	23.5		
2	5	13.5	6	17.6		
3	13	35.1	10	29.4		
4	10	27.0	8	23.5		
5	2	5.4	1	2.9		
Grade					$\chi^2 = .50$	.920
<60%	1	2.7	1	2.9		
60-70%	9	24.3	9	26.5		
70-80%	16	43.2	13	38.2		
>80%	9	24.3	11	32.4		
Past Therapy					$\chi^2 = 2.34$	.126
Yes	15	40.5	8	23.5		
No	22	59.5	26	76.5		
Previous Diagnosis***					$\chi^2 = 1.72$	.424
Yes	9	24.3	4	11.8		
No	27	73.0	28	82.4		
Prefer Not to Answer	1	12.7	1	2.9		
Brain Injury					$\chi^2 = .32$	.574

Yes****	2	5.4	3	8.8		
No	35	94.6	31	91.2		
Neurological Diagnosis					$\chi^2 = .93$	.334
Yes	1	2.7	0	0		
No	36	97.3	34	100.0		
Mindfulness Experience					$\chi^2 = 7.03$	.134
No experience	15	40.5	23	67.6		
Highly Variable	17	45.9	9	26,5		
<3times per week <6 mos	1	2.7	1	2.9		
<3 times per week >6 mos	1	2.7	1	2.9		
>4 times a week >6mos	3	8.1	0	0		

Note. * All spoke English conversationally >3 years; ** One participant spoke English conversationally >3 years, one for 1-3 years; *** One participant in the waitlist did not answer; **** No loss of consciousness or hospitalizations reported.

Table 2. 3

Descriptive Statistics of Study II Measures

Measure	Range	Mean	*SD*	Cronbach's alpha
FFMQ - Mindfulness (time 1)	57-147	95.88	18.29	0.92
FFMQ - Mindfulness (time 2)	55-144	104.18	17.39	0.92
BFI – Conscientiousness	13-45	31.82	5.77	0.76
BFI - Neuroticism	11-40	25.41	6.59	0.83

Note: Abbreviations: FFMQ = Five Facet Mindfulness Questionnaire, BFI = Big Five Inventory

Table 2. 4

Intercorrelations Between Predictor Variables for Primary Analysis

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Age	1									
2. Gender	.06	1								
3. Ethnicity	.01	.05	1							
4. Language	-.05	.00	-.03	1						
5. Employment	-.10	.05	.05	-.04	1					
6. Group	-.18	.02	.08	-.12	-.15	1				
7. Pre FFMQ	.16	.08	.05	-.11	-.06	.08	1			
8. BFI- C	.08	.08	.01	-.04	-.03	.00	.59**	1		
9. BFI- N	.16	-.21	.03	-.17	.05	-.22	-.63**	-.47**	1	
10. Post- FFMQ	-.03	.01	-.12	-.06	-.04	-.14	.72**	.56**	-.56**	1

Note. Abbreviations: FFMQ = Five Facet Mindfulness Questionnaire, BFI = Big Five Inventory, C = Conscientiousness, N = Neuroticism. C*orrelation significant at the* ***p* $\leq$ .001

Table 2. 5

Descriptive Statistics of Study II Predictors

	Group			
	Mindfulness Intervention		Waitlist Control	
Variable	Range	Mean (SD)	Range	Mean (SD)
Postintervention Mindfulness	62-141	94.22(18.47)	57-128	97.03(16.14)
BFI Conscientiousness	16-43	31.65(6.23)	13-41	31.62(5.51)
BFI Neuroticism	13-40	26.70(6.48)	14-38	23.88(6.12)
Computer-timed Compliance (min)	0-298	100.05 (71.42)	--	--

Table 2. 6

Multiple Regression Predicting Postintervention Mindfulness

Predictor	β	*SE*	*t*	*P*	95% CI for β
Preintervention FFMQ	0.505	0.110	4.611	.000***	0.286 to .724
BFI Conscientiousness	0.470	0.289	1.629	.108	-0.106 to 1.047
BFI Neuroticism	-0.604	0.279	-2.168	.034*	-1.161 to -.048
Group Membership	-7.977	2.754	-2.897	.005**	-13.476 to -2.479

Note. Abbreviations: : FFMQ = Five Facet Mindfulness Questionnaire, BFI = Big Five Inventory. C*orrelation significant at the* $*p \leq .05$, $**p \leq .01$, $***p \leq .001$.

Table 2. 7

Intercorrelations Between Predictor Variables for Secondary Analysis

	1.	2.	3.	4.	5.
1. Pre FFMQ	1				
2. BFI- C	.593**	1			
3. BFI- N	-.616**	-.448**	1		
4. Post- FFMQ	.643**	.689**	-.553**	1	
5. Computer-timed Time	.168	.086	.046	.083	1

Note. Abbreviations: FFMQ = Five Facet Mindfulness Questionnaire, BFI = Big Five Inventory. ***Correlation significant at the p ≤ 0.01 level.*

Table 2. 8

Multiple Regression Predicting Postintervention Mindfulness using Computer-timed Compliance Among Participants Who Received the Internet Delivered Mindfulness Based Intervention (ID-MBI)

Predictor	β	*SE*	*t*	*P*	95% CI for β
Preintervention FFMQ	0.224	.157	1.429	.163	-0.095 to .542
BFI Conscientiousness	1.178	.416	2.835	.008*	0.332 to 2.024
BFI Neuroticism	-0.502	.390	-1.286	.208	-1.296 to .293
Computer-timed Compliance	0.003	.028	0.106	.916	-0.055 to .061

Note. Abbreviations FFMQ = Five Facet Mindfulness Questionnaire, BFI = Big Five Inventory. *$p \leq .01$.

CHAPTER 5

Study III: The impact of an Internet-delivered Mindfulness-based intervention on psychological health and emotion regulation and investigation of mechanisms of change

Mindfulness-based interventions (MBIs) have been implemented with individuals who are psychologically healthy and seeking to increase emotional well-being (e.g., Keng, Smoski, & Robins, 2011), as well as with various clinical populations (e.g., Goldberg et al., 2018; Khoury et al., 2013). Randomized controlled trials examining the impacts of MBIs on psychological well-being have found them to be effective at improving various psychological outcomes and emotion regulation in healthy adults (Keng, Smoski, & Robins, 2013). However, the impact of these interventions for students in higher education is less clear (Conley, Durlak, & Dickson, 2013). Researchers have begun to assess the benefits of MBIs in undergraduate and graduate level students and results suggest that MBIs may have positive effects on psychological symptoms such as perceived stress, anxiety, depression, and interpersonal well-being (e.g., Cohen & Miller, 2009), which is important given that university students are more likely than their peers who are not attending post-secondary institutions to report elevated levels of distress (Ontario College Health Association, 2009).

Mindfulness in Higher Education

The National College Health Assessment, a national survey of student mental health (Canadian Consortium of the American College Health Association, 2016) with approximately 40,000 student respondents from 41 Canadian higher education institutions, reported that stress, anxiety, and depression were significant challenges

reported by students. For example, 42.2% and 32.6% of students reported stress and anxiety, respectively, as the most prevalent factor that impacted academic performance. Moreover, 14.7% of the respondents reported a formal diagnosis of depression, which represented an increase from previous years (ACHA National College Health Assessment II, 2016). For these reasons, higher education institutions have been implementing policy and programming changes to improve student mental health. The focus has shifted from individual treatment to more broadly implementing institutional structures and policies related to mental health, increasing mental health awareness, creating a supportive campus climate, and targeting at risk populations (CACUSS & CMHA, 2013; Olding & Yip, 2014).

MBIs are becoming increasingly utilized to promote resilience and treat mental health problems within higher education institutions (Cieslak, et al., 2016). In student populations, trait mindfulness is negatively associated with a number of maladaptive health behaviors, such as binge eating, poor sleep, and number of work/school days missed due to mental and physical health reasons (Roberts & Danoff-Burg, 2010). Furthermore, it appears stress partially mediates the relationship between mindfulness and these health behaviors, suggesting that increased mindfulness leads to decreased stress, which in turn may reduce these unhealthy behaviors (Roberts & Danoff-Burg, 2010).

Generally, the MBIs implemented within higher education institutions have been traditional 8-week, group-based MBIs investigating psychological symptoms such as anxiety, stress, and depression. Traditional MBIs implemented in higher education institutions with university students have been shown to decrease negative affect

(Collard, Avny, & Boniwell, 2009), perceived stress (e.g., Lynch, Gander, Kohls, Kudielka, & Walach 2011), anxiety (e.g., (Lynch et al., 2011), and depression (Lynch et al., 2011), and increase self-compassion (Hindman et al., 2015), psychological flexibility (Hindman et al., 2015), psychological well-being (Van Gordon et al., 2014), and mindfulness (e.g., Collard et al., 2009; Lynch et al., 2011).

Although MBIs have been successfully implemented in higher education institutions with success, clinicians and researchers have cited difficulties with running these programs on campus. For example, there are high attrition rates, which could be related to student complaints such as conflicting scheduling, transportation to campus, and difficulty managing the time commitment required for participation given academic obligations. For these reasons, it has been suggested that the use of online programs for student mental wellness may prove to be a feasible option to reach a larger number of students at a lower cost and to reduce perceived barriers to treatment (Eisenberg, Lipson, & Posselt, 2016).

Internet-Delivered Mindfulness and Treatment Outcomes

Three randomized control trials have investigated the impacts of Internet-delivered MBIs (ID-MBIs) in student populations. Cavanagh and colleagues (2013) conducted a brief 2-week self-guided online mindfulness-based intervention. A significant increase in mindfulness, a decrease in perceived stress, and a decrease in self-reported symptoms of anxiety and depression was found immediately postintervention. No follow-up was conducted. Mak and colleagues (2015) recruited university students and staff for a randomized controlled trial to compare an 8-week mindfulness intervention, 8-week health action process approach (HAPA; guidelines to increase

planning and effectiveness of exercises by developing strategies to deal with obstacles to treatment that may be encountered) with enhanced mindfulness, and waitlist control. The HAPA condition was identical to the online mindfulness program, with infusion of HAPA specific guidelines aimed to increase planning of and effectiveness of exercises by developing coping strategies to deal with obstacles and barriers to treatment that may be encountered. The authors found that the HAPA-enhanced group demonstrated higher levels of mindfulness postintervention and significant increases in life satisfaction at the 3-month follow-up. Furthermore, the mindfulness and HAPA-enhanced mindfulness groups demonstrated improved mental well-being. No significant effect was found on perceived stress or psychological symptoms. In the third evaluation, Messer, Horan, and Weber (2016) completed a randomized control trial investigating the effects of an ID-MBI, relaxation training condition, and a no-treatment control group on stress, coping, and mindfulness. Results indicated that both the mindfulness and relaxation groups had significantly reduced stress as compared to the control condition. They also found that the mindfulness group demonstrated significant decreases in emotion-oriented coping.

Given that some preliminary work has shown ID-MBIs to reduce depression, anxiety, and stress, further work is required to replicate these findings and to determine how MBIs may impact other outcomes related to mental health and well-being. As a result of the extensive literature that has demonstrated the efficacy of MBIs in clinical and nonclinical populations, as well as the newly emerging research on ID-MBIs, researchers have begun to explore the mechanisms of change in MBIs related to therapeutic outcomes. This may be a particularly important area of investigation for ID-MBIs given the relatively new interest in delivering mindfulness online.

Mindfulness and Mechanisms of Change

A systematic review of the literature investing mechanisms of change in MBI research has identified several proposed mechanisms of change. The most studied potential mechanism of change in MBIs research is mindfulness, unsurprisingly, given that changes in mindfulness are theorized to be the mechanism of action for various MBIs, such as MBCT and MBSR (Kabat-Zinm, 1982; Segal et al., 2002). Findings of the systematic review found 12 RCTs and four quasi-experimental studies that investigated mindfulness as a mechanism of change (Gu et al., 2015). The studies varied in terms of outcome measures of interest (e.g., stress, depression, anxiety) and the populations assessed (e.g., adults with depression, anxiety disorders, nonclinical samples). Using a two-stage structural equation model (TSSEM), the authors integrated meta-analytic techniques with SEM. Sixteen studies included in the TSSEM analysis revealed that mindfulness significantly mediated the effects of traditional MBIs on mental health outcomes.

A narrative review of the literature also identified cognitive and emotional processes to have moderate, consistent evidence for mediation effects in MBIs; however, there was not a large enough sample size to conduct TSSEM. There have been some mixed findings with regard to the mediation effects of cognitive and emotional processes in various clinical and subclinical populations. For example, in a study of individuals who met criteria for a current episode of major depressive disorder the relation between treatment and outcome was mediated by cognitive and mindfulness processes (van Aalderen et al., 2012); however, in a study of individuals with subclinical residual

depressive symptoms the relation between intervention and outcomes was mediated by affective processes (specifically changes in positive affect; Batink et al., 2013).

Another proposed mechanism of change in MBIs is psychological flexibility. Psychological flexibility is defined as how well a person is able to accept thoughts, feelings, and experiences in the present moment without using experiential avoidance (Hayes et al., 2006). It has also been conceptualized as encompassing four components related to how a person: (a) adapts to fluctuating situational demands; (b) reconfigures mental resources; (c) shifts perspective; and (d) balances competing desires, needs, and life domains (Kashdan & Rotterburg, 2010). Review of the literature suggests that there is preliminary but insufficient evidence to support psychological flexibility as a mechanism of change in MBIs at the present time; however, further investigation is warranted (Gu et al., 2015). Cumulatively, this research suggests that perhaps the mediation of effects is different for different populations.

Establishing mechanisms of change in psychotherapeutic interventions has several important implications. It can help to increase understanding and enhance intervention effectiveness, by enhancing the active components of the interventions in treatments, and can help to determine who may benefit from particular interventions (Kazdin, 2007). If increased mindfulness, psychological flexibility, and positive affect mediate the relationship between MBIs and psychological outcomes, these online interventions would not only be beneficial for clinical populations, but could also be implemented to target healthy and at-risk emerging adults/students, as mindfulness, psychological flexibility, and positive affect have all been shown important for general health and well-being (e.g., Cieslak, et al., 2016; Kashdan & Rottenberg, 2010). Thus, implementing ID-MBIs within

higher education institutions could be an effective and feasible program option for promoting mental health awareness, targeting at-risk students, and treating individuals with mental health disorders.

Study Aims and Hypothesis

Clinicians who have attempted to run MBIs on university campuses cite difficulties such as conflicting scheduling, transportation to campus, and stigma as potential difficulties with recruitment and feasibility. Given that students report higher levels of distress than their nonuniversity peers and seek help less readily (Ontario College Health Association, 2009), implementing Internet-delivered interventions could prove to increase access to programs aimed at improving well-being in a cost effective and time efficient manner, while reducing perceived barriers to treatment such as stigma, limited availability, and conflicting schedules. Preliminary work has been conducted on ID-MBIs and has demonstrated that they may offer benefits for nonclinical groups. The literature has focused primarily on psychological outcomes such as stress, depression, and anxiety. The proposed study investigated the use of an ID-MBI for nonclinical outcomes such as psychological flexibility, emotion regulation, and positive affectivity, as well as a broad range of psychological symptoms and perceived stress. If participants report improved outcomes following the intervention, it may be a beneficial program for nonclinical and clinical populations for prevention and treatment purposes.

Study Aim

The current study's aim was to determine how an Internet-delivered mindfulness-based intervention impacted psychological symptoms and emotion regulation in a sample of university students and to explore potential mediators of the effects.

Hypothesis 1. It was hypothesized that participants in the ID-MBI condition would report improved emotion regulation from pre to postintervention as compared to the waitlist control condition.

Hypothesis 2. It was hypothesized that participants in the ID-MBI condition would report lower perceived stress from pre to postintervention as compared to the waitlist control condition.

Hypothesis 3. It was hypothesized that participants in the ID-MBI condition would report higher mindfulness from pre to postintervention as compared to the waitlist control condition.

Hypothesis 4. It was hypothesized that participants in the ID-MBI condition would report lower negative affect from pre to postintervention as compared to the waitlist control condition.

Hypothesis 5. It was hypothesized that participants in the ID-MBI condition would report lower emotional distress from pre to postintervention as compared to the waitlist control condition.

Hypothesis 6. Additionally, it was hypothesized that increases in mindfulness, psychological flexibility, and positive affect would partially mediate the effects of the ID-MBI on postintervention psychological outcomes.

Methods

Participants

A priori power analyses were conducted using the program G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007). To determine the required sample size for a mixed factor ANOVA with one within- and one between-subjects factor (described below), a

power of .80, alpha value of .05, and a medium effect size were specified. It determined a sample size of 34 participants was required. Additionally, for a simple mediation with two predictors, a power of .80, alpha value of .05, and an effect size of $f^2 = 0.15$, the required sample size was 68.

Participants ($N = 84$, female $n = 74$) ages 17-49 years old ($M = 21.39$, $SD = 4.06$) were enrolled from the University of Windsor's psychology department participant pool from September 2017 to July 2018. The retained group (N = 71, female $n = 61$) ranged in age from 17 to 49 years old ($M = 21.28$, $SD = 4.16$) and participants lost to attrition ($N = 13$) were all female and ranged in age from 18 to 30 years old ($M = 22.00$, $SD = 3.46$). See Table 1 for detailed demographic information. Compared to community samples, participants in the current study scored one standard deviation above the mean on perceived stress (Cohen & Williamson, 1988), and one standard deviation above the mean on negative affect (Crawford & Henry, 2010). With regard to emotional distress, as measured by the GSI of the BSI-18, the mean score of the participants ($M = 17.90$, SD = 13.49) compared to community normative data was a t-score of 61. A t-score of >63 indicates clinically significant emotional distress. Twenty-five participants reported clinically significant distress (approximately 35% of the total sample).

T-test and chi-square tests were used to analyze group differences on demographic and preintervention variables (e.g., mindfulness, perceived stress, and psychological symptoms) between the attrition group and retained group. Bivariate analyses conducted to determine differences between the attrition and retained groups demonstrated that participants in the drop-out group were more heavily represented by participants who identified English as a second language ($\chi^2 (1) = 7.34$, $p < .001$). The

groups did not differ significantly on any other demographic variables ($p > .05$) or any other preintervention variables such as mindfulness or emotional distress ($p > .05$). See Table 1.

T-test and chi-square tests were used to analyze group differences on demographic and preintervention variables (e.g., mindfulness, perceived stress, and psychological symptoms) between the intervention and waitlist group to determine if there were any significant preintervention differences. Bivariate analyses demonstrated that the groups did not differ significantly on any demographic variables ($p > .05$). With regard to other preintervention variables, there were no significant differences between the groups ($p > .05$). See table 1.

Procedures

Participants were recruited through the departmental research participant pool. Participants who met eligibility criteria were randomly assigned to the mindfulness intervention or waitlist upon arrival for the preintervention assessment. Following completion of the intervention, participants in the waitlist group were offered the programming. See Chapter 2 for detailed procedures. All procedures were approved by the University of Windsor Research Ethics Board.

Measures

Demographics. Data including age, gender, ethnicity, years of education, language, mindfulness/meditation experience, and other descriptions were assessed with a questionnaire at baseline (see Appendix B). These data were used to describe the sample. Furthermore, if outliers or influential observations were noted then these demographics variables may help to understand the mechanism. For example, individuals

who report English as a second language and poor conversational English may not benefit from the audio exercises as much as their English-speaking peers.

Mindfulness. Mindfulness was assessed at the beginning and the end of intervention using the Five Facet Mindfulness Questionnaires (FFMQ; Baer et al., 2006). A trait measure of mindfulness was used to determine if the intervention increases dispositional mindfulness through increases in state mindfulness by practice across the four-week intervention. The FFMQ is a 39-item self-report measure. Items are rated on a 5-point Likert scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*). The scale consists of five factors: Observing, Describing, Acting with Awareness, Nonjudging, and Nonreactivity. However, as recommended, only the four factors Describing, Acting with Awareness, Nonjudging, and Nonreactivity was be used in the total (i.e., sum) score in the current study to measure pre- and postmindfulness scores (Gu et al., 2016) due to differences found in the factor structure for nonmeditators and meditators. Factor analysis has demonstrated that a four-factor model (without the Observing scale) provides the best fit for individuals with little or no meditation experience (Baer et al., 2006; Gu et al., 2016). It is suggested that this four-factor model has better fit in nonmeditators because Observing has a nonsignificant relation to Nonjudging and Acting with awareness in individuals with little or no meditation experience (Baer et al., 2006, Curtiss & Klemanski, 2014). Thus, in nonmeditators the Observing scale may reflect attention to experiences in a neutral or negative way (e.g., anxious monitoring of experience), and not the participant's abilities to observe experiences mindfully in a curious and nonjudgmental manner (Gu et al., 2016). For this reason, a total FFMQ score containing the four factors Describing, Acting with

Awareness, Nonjudging, and Nonreactivity, has been recommended as a more accurate measure of mindfulness in individuals with little to no formal meditation experiences, such as students. The FFMQ has demonstrated good internal consistency and has been validated for use in college sample (Baer et al., 2006a, 2006b, 2008), and validated in individuals with little to no meditation experience (Baer et al., 2006; Gu et al., 2016). The dependent variable in the current study was be the four-factor total FFMQ score. In the current analysis, the scale demonstrated good internal consistency at pre and postintervention (see Table 3).

Emotion regulation. The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) was used to assess deficits in emotion regulation. The DERS contains 36 items and items are scored on a Likert scale ranging from 1 (*Almost never*) to 5 (*Almost always*). Higher scores on the DERS indicate greater dysregulation of emotions. The DERS is composed of six subscales: Lack of Acceptance of Emotional Responses, Lack of Emotional Awareness, Lack of Emotional Clarity, Limited Access to Effective Emotion Regulation Strategies, Lack of Impulse Control, and Difficulties Engaging in Goal-Directed Behaviour when experiencing distress. Higher scores indicate greater emotion dysregulation. A total sum score was be used in the current analysis. The DERS demonstrated high internal consistency ($\alpha = 0.93$) and good test-retest reliability (Gratz & Roemer, 2004). In the current analysis, the scale demonstrated good internal consistency at pre- and postintervention (see Table 3).

Affect. The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was used to measure mood. The scale assesses to what degree an individual is feeling various emotions at that moment. The scale consists of 20 items that

are rated on a 5-point Likert scale from 1 (*Very Slightly or Not at All*) to 5 (*Extremely*). The measure is composed of two subscales: positive affect and negative affect. Higher scores on the subscales represent higher levels of positive and negative affect, respectively. Both the Positive and Negative Affect scales were used in the current analysis. Total scores on the positive and negative affect scale reflect sum scores of the 10-items on each scale. Reliability and validity have been demonstrated to be good (Watson et al., 1988). Specifically, the scale showed good internal consistency for both the positive and negative affect subscales (0.86-0.90 and 0.84-0.87, respectively). In the current analysis, both scales demonstrated good internal consistency at pre- and postintervention (see Table 3).

Psychological flexibility. The Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011) was used as a measure of psychological flexibility and experiential avoidance. The scale is composed of 10 items, which are answered on a 7-point Likert scale ranging from 1 (*never true*) to 7 (*always true*). Research has demonstrated adequate internal consistency (α = .78–.88) and test–retest reliability at 3- and 12-months (.81 and .79, respectively; Bond et al., 2011). Lower scores indicate greater psychological flexibility. The total score was used in the analysis. In the current analysis, the scale demonstrated good internal consistency at pre- and postintervention (see Table 3).

Psychological symptoms. The Brief Symptom Inventory 18 (BSI-18; Derogatis, 2000) was used to assess psychological symptoms and somatic complaints. The measure is composed of 18 items, which correspond to three six-item subscales (i.e., somatization, [SOM] depression [DEP], and anxiety, [ANX]) and a global severity index (GSI) score. Items are answered on a 5-point rating scale whereby participants rate the extent to which

they have been bothered (0 = *not at all* to 4 = *extremely*) by various symptoms. Research has demonstrated adequate internal consistency (SOM [.74], DEP [.84], ANX [.89]; Derogatis, 2000). The subscale sum scores range from 0-24 and the GSI range between 0-72. The global severity index (GSI) was calculated and used in the current study as a measure of psychological symptoms; the GSI is the sum of the subscale scores. In the current analysis, the scale demonstrated good internal consistency at pre- and postintervention (see Table 3).

Perceived stress. The Perceived Stress Scale (PSS-10; Cohen & Williamson; 1988) is a 10-item measure that was used to assess perceived stress over the last month. The PSS has been demonstrated to have good internal consistency ($\alpha = 0.84 - 0.86$; Cohen, 1983). Items are scored on a 5-point Likert scale from 0 (*never*) to 4 (*very often*). Higher scores on the PSS reflect a greater degree of perceived stress. The total score was used in the analysis. In the current analysis, the scale demonstrated good internal consistency at pre- and postintervention (see Table 3).

Client satisfaction questionnaire. The Client Satisfaction Questionnaire (CSQ) is a 10-item measure used to assess satisfaction with treatment that was adapted for use within the current student. The CSQ items are scored on a 4-point Likert scale, with higher scores corresponding with higher satisfaction with the intervention. The CSQ asks about a number of different aspect of satisfaction, including satisfaction with services, satisfaction with support received, whether content was engaging, whether participants needs were met.

Data Analysis

Preliminary analyses. Prior to conducting the primary analyses, I tested the assumptions of ANOVA. Assumptions for the 2x2 mixed factor ANOVA include normality of variables (e.g., histograms, boxplots), absence of outliers (e.g., Cook's distance, Mahalanobis distance), and homogeneity of variances (e.g., Levene's test). Prior to conducting secondary analyses, I tested the assumptions of mediation analyses, which included independence of observations (e.g., Durbin-Watson statistic), normality of variables (e.g., histograms, boxplots), linear relationship between independent and dependent variables (e.g., scatter plots), absence of multicollinearity (e.g., correlation coefficients, VIF/Tolerance values), homoscedasticity (e.g., scatterplot), and absence of outliers (e.g., Cook's distance, Mahalanobis distance). In the case that assumptions were violated, the data were cleaned and transformed. Missing data were examined by conducting a missing value analysis. The method of handling the missing data was selected based on results of the analysis.

Primary analyses. To determine if the intervention was successful at improving psychological health and emotion regulation, a series 2 x 2 repeated measures ANOVA with group (MBI and waitlist) as a between-subjects factors and time (pre- and postintervention) as a within-subjects factor were conducted for each outcome variable (i.e., perceived stress, psychological symptoms, emotion regulation, mindfulness, negative affect). Effect sizes were calculated for each outcome. Bonferonni adjustments were not made; however, effect sizes are presented to provide information on the magnitude of treatment effect.

Secondary analyses. Exploratory correlations were conducted to examine how the measures relate to each other for the purposes of conducting mediation analyses. The mediation analyses examined the indirect influence of group (X) on the outcome (Y) through the hypothesized mediators (M). The outcome in the mediation analyses was emotion regulation. Mediation analyses were conducted using Hayes' statistical macro for SPSS, *Process* (Hayes, 2012). The macro provides code to conduct simple mediations (Model 4), while controlling for the participants' scores on the dependent measure and mediator preintervention. *Process* uses bootstrapping, which draws random samples from the original data set and the proposed mediation model is conducted on each of the random samples; 5000 bootstrap samples were used for these mediations. Confidence intervals for the range of Beta coefficients (*b*) produced by the bootstrap are presented. A confidence interval that does not include zero indicates that 95% of cases have a *b* value that is positive, and therefore suggests a significant positive effect. However, a confidence interval including zero does not allow for clear effects to be seen, indicating a range of *b* values including negative effects, positive effects, or no effects.

The indirect effect of the mediator on the outcome was assessed to examine whether or not an increase in psychological flexibility, positive affect, and mindfulness (M's) following the intervention (X) would mediate the effects of the intervention on emotion regulation postintervention (Y). Analyses were conducted using SPSS statistical package version 23 (SPSS Inc, Chicago, IL).

Results

Missing data were a result of item nonresponse, in which subjects did not provide information for some items. Given data is missing completely at random (MCAR; χ^2

(2004) = 0.0, p >.05), and the percentage of missing data is low (<0.0011%), procedures outlined in each respective measure was used to prorate the scale for participants with missing items.

Primary Analysis

Assumption testing. Assumptions for the repeated measures ANOVA include normality of variables (e.g., histograms, boxplots), absence of outliers, and homogeneity of variance. Assumption testing for each ANOVA is reported below.

Emotion regulation. There were no outliers, as assessed by examination of studentized residuals; no values on the DERS (pre- or postintervention) were greater than ±3. As assessed by visual inspection of Q-Q Plots of the studentized residuals, histogram of the distribution, and Shapiro-Wilks' test (p > .05), the data met the assumption of normality. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance (p > .05). There was homogeneity of covariances, as assessed by Box's test of equality of covariance matrices (p = .546).

There was a statistically significant interaction between the intervention and time on emotion regulation, $F(1, 69) = 15.33$ $p < .001$, partial $\eta^2 = .182$. There was not a significant difference on emotion regulation total score between the intervention and waitlist group preintervention ($F(1, 69) = 0.782$, $p = .380$, partial $\eta^2 = .011$) or postintervention ($F(1,69) = 3.68$, $p = .059$, partial $\eta^2 = .051$). As predicted, in hypothesis 1, there was a simple main effect of time on emotion regulation for the mindfulness group; the mindfulness group had significantly lower scores on the difficulties with emotion regulation scale from preintervention to postintervention, $F(1, 36) = 29.082$, $p <$ .001, partial $\eta^2 = .447$, with lower scores at postintervention than preintervetnion. There

was no statistically significant effect of time on emotion regulation for the waitlist group, $F(1, 33) = 0.043$ $p = .8.37$, partial $\eta^2 = .001$.

Perceived stress. There were no outliers, as assessed by examination of studentized residuals; no values on the PSS (pre- or postintervention) were greater than ±3. As assessed by visual inspection of Q-Q Plots of the studentized residuals, histogram of the distribution, and Shapiro-Wilks test ($p > .05$), the data met the assumption of normality. The only exception was a significant Shapiro-Wilks' test for postintervention PSS for the waitlist group; however, examination of distribution, Q-Q Plots, and skewness and kurtosis values indicated adequate normality. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). There was homogeneity of covariances, as assessed by Box's test of equality of covariance matrices ($p = .086$).

There was a statistically significant interaction between the intervention and time on perceived stress, $F(1, 69) = 7.874$, $p = .007$, partial $\eta^2 = .102$. There was no significant difference in the total perceived stress score between the intervention and waitlist group preintervention ($F(1, 69 = 1.551$, $p = .217$, partial $\eta^2 = .022$) or postintervention ($F(1,69) = 1.065$, $p = .306$, partial $\eta^2 = .015$). As predicted, in hypothesis 2, there was a statistically significant effect of time on perceived stress for the mindfulness group, $F(1, 36) = 6.805$, $p = .013$, partial $\eta^2 = .159$, with lower scores at postintervention than preintervention. There was no statistically significant effect of time on perceived stress for the waitlist group, $F(1, 33) = 1.573$ $p = .219$, partial $\eta^2 = .045$.

Mindfulness. There were no outliers, as assessed by examination of studentized residuals; no values on the FFMQ (pre- or postintervention) were greater than ±3. As

assessed by visual inspection of Q-Q Plots of the studentized residuals, histogram of the distribution, and Shapiro-Wilks test (p >.05), the data met the assumption of normality. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance (p > .05). There was homogeneity of covariances, as assessed by Box's test of equality of covariance matrices (p = .024).

There was a statistically significant interaction between the intervention and time on mindfulness, $F(1, 69) = 6.626$, $p = .012$, partial $\eta^2 = .088$. There was no significant difference on the total mindfulness score between the intervention and waitlist group preintervention ($F(1, 69) = 0.463$, $p = .498$, partial $\eta^2 = .007$) or postintervention ($F(1,69) = 1.395$, $p = .242$, partial $\eta^2 = .020$). As predicted in hypothesis 3, there was a statistically significant effect of time on mindfulness for the mindfulness group, $F(1, 36) = 24.875$, $p < .001$, partial $\eta^2 = .409$, with higher scores at postintervention than preintervention. However, contrary to the hypothesis, there was a statistically significant effect of time on mindfulness for the waitlist group, $F(1, 33) = 8.593$, $p = .006$, partial $\eta^2 = .207$.

Negative affect. There was one outlier on postintervention PANAS negative affect, as assessed by examination of studentized residuals (value was greater than ±3). Removing the outlier only marginally improved normality and did not impact results of the ANOVA. As assessed by visual inspection of Q-Q Plots of the studentized residuals, histogram of the distribution, and Shapiro-Wilks test (p >.05), the data met the assumption of normality for preintervention groups, but postintervention waitlist group deviated from normal. The Shapiro-Wilks was significant (p >.05; skew = 3.33, kurtosis was within normal limits). There was homogeneity of variances, as assessed by Levene's

test of homogeneity of variance ($p > .05$). There was homogeneity of covariances, as assessed by Box's test of equality of covariance matrices ($p > .05$). Given that results were only moderately positively skewed for one level of the data, the assumptions of equal variance were met, and ANOVA is robust to some deviation from normal, no transformation was conducted.

There was a statistically significant interaction between the intervention and time on negative affect, $F(1, 69) = 5.423$ $p = .023$, partial $\eta^2 = .073$. There was no significant difference on negative affect between the intervention and waitlist group preintervention ($F(1, 69) = 1.347$, $p = .250$, partial $\eta^2 = .019$) or postintervention ($F(1,69) = 1.688$, $p = .198$, partial $\eta^2 = .024$). In line with hypothesis 4, there was a statistically significant effect of time on negative affect for the mindfulness group, $F(1, 36) = 10.748$, $p = .002$, partial $\eta^2 = .230$, with lower scores at postintervention than preintervention. There was no statistically significant effect of time on negative affect for the waitlist group, $F(1, 33) = 0.012$, $p = .913$, partial $\eta^2 = .000$.

Emotional Distress. There were no outliers on preintervention BSI scores; however, there were two outliers (> ±3 *SD*) on postintervention BSI as assessed by studentized residuals. Shapiro-Wilks tests were significant for pre- and postintervention BSI for both the intervention and waitlist groups. Additionally, skewness values were outside of the traditional cutoffs for each of the groups. Given the variables were positively skewed, square root transformations were completed on the preintervention and postintervention BSI scores. After the variables were transformed, visual inspection of Q-Q Plots of the studentized residuals, histogram of the distribution, and Shapiro-Wilks test ($p > .05$) indicated that the data met the assumption of normality and absence

of outliers. There was homogeneity of covariances, as assessed by Box's test of equality of covariance matrices (p = .142).

Contrary to hypothesis 5, there was no statistically significant interaction between intervention and time, $F(1, 68) = 2.491$, p = .119, partial η^2 = .035. There was no main effect of time on mean emotional distress at Time 1 and Time 2, $F(1, 68) = 2.493$, p = .053 partial η^2 = .054. There was no main effect of group ($F(1, 68) = 0..00$, p = .993, partial η^2 = .000.

Reliable Change indexes. To determine how meaningful change was on the primary outcome measures for participants in the intervention group, reliable change indexes were calculated. With regard to emotion regulation, 68% of participants reported reliable improvement on emotion regulation, 30% did not report reliable change, and 2% reported decline. On perceived stress 43% reported reliable reductions in perceived stress, 41% did not report reliable change, and 11% reported reliably higher perceived stress. For mindfulness, 54% reported reliably higher mindfulness and 46% did not reported reliable change, no participants reported reliable reductions in mindfulness. With regard to negative affect, 32% reported reliable reductions, 62% reported no reliable change, and 5% reported reliable increases.

Secondary Analyses

The AAQ and PANAS-PA data were checked for normality and outliers, as these were the only variables not assessed in the primary analyses. There were no outliers, as assessed by examination of studentized residuals. As assessed by visual inspection of Q-Q Plots of the studentized residuals, histogram of the distribution, and Shapiro-Wilks test (p > .05), the data met the assumption of normality. The only exception was

postintervention AAQ for the mindfulness group, which had a significant Shapiro-Wilks result ($p > 0.05$, skewness = 2.78, kurtosis within acceptable range). Given that results were only moderately positively skewed for one level of the data and mediation is robust to some deviation from normality due to the use of bootstrapping, no transformation was conducted. Bivariate correlations between all variables are presented in Table 4.

Three Process analyses were conducted; each analysis utilized postintervention emotion regulation as the dependent variable and group membership as the independent variable (i.e., 0 = mindfulness group, 1 = waitlist group). Each analysis assessed a different mediator variable (i.e., psychological flexibility, mindfulness, and positive affect). In each of the Process analyses, the preintervention score on the moderator and outcome variable were used as covariates.

Positive affect. The model was significant, $R = 0.816$, $R^2 = .666$, $F(4, 66) = 32.93$, $p < .001$ (see Figure 1). Namely, after controlling for preintervention emotion regulation and positive affect, group membership predicted postintervention positive affect, $a = -5.75$ $t = -4.175$, $p < .001$, 95% CI [-8.51, -3.00] and postintervention positive affect predicted postintervention emotion regulation, b = -1.17, $t = -4.169$, $p < .001$, 95% CI [-1.734, -0.611]. There was no direct effect of group membership on postintervention emotion regulation, c' = 6.43, 95% CI [-0.684, 13.545]; however, there was a significant indirect effect of group on postintervention emotion regulation through positive affect, $ab = 6.751$, 95% CI [2.92, 13.545]. Thus, as predicted in hypothesis 6, being in the mindfulness group predicted higher positive affect, and higher positive affect predicted better emotion regulation. See Figure 6.

Mindfulness. The overall model was significant, $R = 0.93$, $R^2 = .87$, $F(4, 66) =$

108.02 , $p < .001$ (see Figure 2). After controlling for preintervention emotion regulation and mindfulness, group membership predicted postintervention mindfulness, $a = -7.18$, $t = -2.56$, $p = .013$, 95% CI [-12.77, -1.59] and postintervention mindfulness predicted postintervention emotion regulation, $b = -1.029$, $t = -11.86$, $p < .001$, 95% CI [-1.20, -0.87]. There was a significant direct effect of group membership on postintervention emotion regulation, ‘$c = 5.90$, $t = 2.83$, $p = .006$, 95% CI [1.73, 10.06], and a significant indirect effect of group on postintervention emotion regulation through mindfulness, $ab = 7.39$, 95% CI[2.09, 13.10]. Therefore, as predicted in hypothesis 6, membership in the intervention group predicted higher levels of mindfulness, and higher mindfulness was related to better emotion regulation. See Figure 7.

Psychological flexibility. The overall model was significant, $R = 0.86$, $R^2 = .74$, $F(4, 66) = 47.71$, $p < .001$ (see Figure 3). After controlling for preintervention emotion regulation and psychological flexibility, group membership predicted psychological flexibility, $a = 5.17$, $t = 3.49$, $p = .0009$, 95% CI [2.21, 8.14] and psychological flexibility predicted emotion regulation, $b = -1.38$, $t = 6.05$, $p < .001$, 95% CI [0.92, 1.84]. There was a significant direct effect of group membership on postintervention emotion regulation, $c' = 6.06$, $t = 2.01$, $p = .048$, 95% CI [0.04, 12.08]. Additionally, there was a significant indirect effect of group on postintervention emotion regulation through psychological flexibility, $ab = 7.15$, 95% CI [3.34, 11.63]. Thus, as predicted in hypothesis 6, membership in the mindfulness group was related to more psychological flexibility, and greater psychological flexibility was related to better emotion regulation. See Figure 8.

Engagement and Satisfaction

With regard to adherence to the intervention, 24% of the participants in the mindfulness group practiced the requested amount of time across the intervention (i.e., total of 200 minutes) and 22% of participants practiced the required 20 days across the months period. Seventy percent practiced at least 100 minutes across the intervention. The majority of participants who completed the intervention reported being "mostly" satisfied with the program (56.8%), that "Most" of their needs were met (64.9%), were "mostly" satisfied with the amount of help they received (48.6%), they would "yes, definitely" recommend the program to someone else (54.1%), and "yes, it helped" them deal more effectively with their problems/distress (59.5%). When asked about whether the program was engaging, the majority of participants responded "yes, I think so" (64.9%) and they would continue to practice mindfulness (51.4%).

Discussion

This was the first known study to assess possible mechanisms of change in an internet-delivered mindfulness-based intervention (ID-MBI) while also seeking to clarify the impacts of the 4-week ID-MBI on emotion regulation, perceived stress, mindfulness, negative affect, and psychological symptoms. With regard to the impact of the intervention, as compared to the waitlist group the mindfulness group showed significant improvement on emotion regulation, reduced perceived stress, increases in mindfulness, and reduced negative affect, indicating that the program improved participants' abilities to cope with emotional difficulties and reduced frequency of negative emotions. These findings are consistent with previous work that has shown the utility of mindfulness programming with university student samples. A number of studies have found decreases in negative affect (Collard, Avny, & Boniwell, 2009) and perceived stress (e.g., Lynch,

Gander, Kohls, Kudielka, & Walach 2011), and increases in psychological well-being (Van Gordon et al., 2014) and mindfulness (e.g., Collard et al., 2009; Lynch et al., 2011) following traditional in person MBIs. With regard to ID-MBIs, no studies have examined the impacts on emotion regulation and negative affect. With regard to mindfulness, the current study found large effects for the mindfulness ,group, compared to meta-analysis across a wide range of participants which has found small effects for mindfulness (g =0.32; Spijkerman et al., 2016). Preliminary work has been somewhat inconsistent with regard to changes in perceived stress following ID-MBIs in student samples with some showing reduced stress (Cavanagh et al., 2013; Messer, Horan, & Webet, 2016) and other studies not finding this association (Mak et al., 2015). In the current analysis, medium effect sizes were found for perceived stress, which is a smaller effect than what has been found in a meta-analysis of ID-MBIs across a range of participant populations (g = 0.51; Spijkerman et al., 2016).

With regard to general emotional distress, as measured by the BSI-18, individuals in the mindfulness group did not report reductions in distress. Limited research in this area has shown mixed results with some demonstrating reductions in depression and anxiety (Cavanagh et al., 2013), and others finding no effects on psychological symptoms (Mak et al., 2015). This was inconsistent with the hypothesis that the program would reduce psychological symptoms compared to the waitlist control; however, this could be related to the nature of the sample. The majority of the same had relatively lower endorsement of psychopathology (approximately 65% of the total sample reported non-clinically significant emotion distress) or it could be that the measure was not sensitive enough to detect changes. Overall, the findings of the current study clarify how an ID-

MBI may improve emotional regulation and reduce perceived stress, which is important given that students report higher levels of distress than their nonuniversity peers (Ontario College Health Association, 2009).

With regard to mechanisms of change, psychological flexibility, positive affect, and mindfulness were all significant mechanisms of change, suggesting that interventions targeting these mediators may lead to improved outcomes for university students. Findings are consistent with previous work investigating mechanisms of change in traditional MBIs, finding mindfulness to be the most well-supported mechanisms of change (Gu et al., 2015). We also provide additional support for psychological flexibility and positive affect as mechanisms of change in ID-MBIs (Gu et al., 2015). Establishing mechanisms of change in psychotherapeutic interventions has several important implications. It may increase understanding and enhance intervention effectiveness, by enhancing the active components of the interventions and may help determine who may benefit from particular interventions (Kazdin, 2007). The intervention improved emotion regulation through increases in mindfulness, psychological flexibility, and positive affect. Thus, this program could be implemented to target healthy and at-risk emerging adults/students, as mindfulness, psychological flexibility, and positive affect have all been shown important for general health and well-being (e.g., Cieslak, et al., 2016; Kashdan & Rottenberg, 2010).

The findings of this study have several important clinical implications. The Internet-delivered mindfulness-based intervention was effective at improving emotion regulation skills while reducing perceived stress and negative affect in university students. The intervention did not improve overall psychological symptoms, which is

consistent with the purpose of mindfulness (i.e., to bring awareness and acceptance to feelings and experiences, without the expectation of changing or reducing negative emotions). Thus, the program helped to improve coping and reduce the perceived stress individuals experienced. Several mechanisms of change were identified and could be targeted in follow-up studies to improve outcomes. For example, additional exercises or psychoeducation material to improve awareness and acceptance of emotion to promote psychological flexibility, could improve outcomes by targeting this mechanism of change. Additionally, attrition was relatively low (approximately 13%), suggesting this may be a feasible, cost-efficient program option for university students seeking ways to improve general well-being.

The study should be considered with the context of its limitations. First, the study was composed primarily of women, which may reduce the generalizability. Future research may seek to determine the intervention's utility within higher education institutions outside of a psychology department's participant pool, to determine if the results generalize with more diverse samples. Additionally, given the use of the participant pool, participants were provided incentive (bonus points) for participation. It is conceivable that this may have impacted the low drop out rate. Implementing the intervention in a community sample may help to determine if dropout remains low and compliance rates remain high. Lastly, the study used primarily self-report-measures, which may introduce common-methods variance.

Overall, the results suggested that the novel ID-MBI could help students improve general well-being and coping skills. With regard to furthering the study of ID- MBIs, future work could incorporate the use of informal mindfulness practice as well as

incorporate specific exercises to target the identified mechanisms of change. Additionally, the implementation of additional technologies, such as the development of a smart phone application could serve to further increase accessibility.

Table 3. 1

Demographic Characteristics of Drop Out and Retained Participants

	Drop out		Retained			
Characteristic	*n*	%	*n*	%	χ^2	*p* value
Gender					$\chi^2 = 2.078$	.149
Female	13	100	61	85.9		
Male	0	0	10	14.1		
Ethnicity					$\chi^2 = 9.50$	.219
Black/ African American	1	7.7	3	4.2		
East Asian	1	7.7	2	2.8		
South Asian/Indian	2	15.4	5	7.0		
Hispanic/Latino	0	0	4	5.6		
Caucasian	6	46.2	40	56.3		
Arab/Middle Eastern	1	7.7	14	19.7		
Biracial	1	7.7	3	4.2		
Other	1	7.7	0	0		
English is first language					$\chi^2 = 7.341$	.007
Yes	8	61.5	64	90.1		
No	5*	38.5	7**	9.9		
Relationship Status					$\chi^2 = 1.49$	.685
Single	6	46.2	40	56.3		
In a relationship	6	46.2	27	38.0		
Married	0	0	2	2.8		
Cohabitating	1	7.7	2	2.8		

Employment					$\chi^2 = 1.744$	.187
Yes	11	84.6	47	66.2		
No	2	15.4	24	33.8		
Year of Study					$\chi^2 = 9.36$	.053
1	2	15.4	15	21.1		
2	4	30.8	11	15.5		
3	1	7.7	23	32.4		
4	3	23.1	18	25.4		
5	3	23.1	3	4.2		
Grade					$\chi^2 = 1.27$	.737
<60%	0	0	2	2.8		
60-70%	4	30.8	18	25.4		
70-80%	6	46.2	29	40.8		
>80%	2	15.4	20	28.2		
Past Therapy***					$\chi^2 = 1.21$	.272
Yes	2	15.4	23	32.4		
No	10	76.9	48	67.6		
Previous Diagnosis***					$\chi^2 = 0.39$	.822
Yes	2	15.4	13	18.3		
No	10	79.6	55	77.5		
Prefer Not to Answer	0	0	2	2.8		
Brain Injury***					$\chi^2 = .1.23$	.267

Yes****	2	15.4	5	7.0		
No	10	76.9	66	93.0		
Neurological Diagnosis***					$\chi^2 = 0.17$	.679
Yes	0	0	1	1.4		
No	12	92.3	70	98.6		
Mindfulness Experience***					$\chi^2 = 2.87$	.581
No experience	4	30.8	38	53.5		
Highly Variable	5	46.2	26	36.6		
<3times per week <6 mos	1	7.7	2	2.8		
>3 times per week <6 mos	0	0	0	0		
<3 times per week >6 mos	0	0	2	1.6		
>3 times a week >6mos	1	7.7	3	4.2		

* Spoke English conversationally >3 years
** Seven spoke English conversationally > 3 years, one for 1-3 years
***One respondent did not answer in drop out group
**** No LOC or hospitalizations reported

Table 3. 2

Demographic Characteristics of Intervention and Waitlist Participants

	MBI		Waitlist			
Characteristic	*n*	%	*n*	%	χ^2	*p* value
Gender					$\chi^2 = 0.21$	.885
Female	32	86.5	29	85.3		
Male	5	13.5	5	14.7		
Ethnicity					$\chi^2 = 9.71$	.137
Black/ African American	1	2.7	2	5.9		
East Asian	2	5.4	0	0		
South Asian/Indian	2	5.4	3	8.8		
Hispanic/Latino	4	10.8	0	0		
Caucasian	20	54.1	20	58.5		
Arab/Middle Eastern	8	21.6	6	17.6		
Biracial	0	0	3	8.8		
Other	0	0	0	0		
English as first language					$\chi^2 = 1.16$	.281
Yes	32	86.5	32	94.1		
No	5*	13.5	2**	5.9		
Relationship Status					$\chi^2 = 5.21$	.157
Single	22	58.5	18	52.9		
In a relationship	11	29.7	16	47,1		
Married	2	5.4	0	0		
Cohabitating	2	5.4	0	0		

Employment					$\chi^2 = 1.57$	.211
Yes	22	59.5	25	73.5		
No	15	40.5	9	26.5		
Year of Study					$\chi^2 = 0.88$	.928
1	7	18.9	8	23.5		
2	5	13.5	6	17.6		
3	13	35.1	10	29.4		
4	10	27.0	8	23.5		
5	2	5.4	1	2.9		
Grade					$\chi^2 = 0.50$	.920
<60%	1	2.7	1	2.9		
60-70%	9	24.3	9	26.5		
70-80%	16	43.2	13	38.2		
>80%	9	24.3	11	32.4		
Past Therapy					$\chi^2 = 2.34$	.126
Yes	15	40.5	8	23.5		
No	22	59.5	26	76.5		
Previous Diagnosis***					$\chi^2 = 1.72$	.424
Yes	9	24.3	4	11.8		
No	27	73.0	28	82.4		
Prefer Not to Answer	1	12.7	1	2.9		
Brain Injury					$\chi^2 = 0.32$	.574

Yes****	2	5.4	3	8.8		
No	35	94.6	31	91.2		
Neurological Diagnosis					$\chi^2 = 0.93$	.334
Yes	1	2.7	0	0		
No	36	97.3	34	100.0		
Mindfulness Experience					$\chi^2 = 7.03$	.134
No experience	15	40.5	23	67.6		
Highly Variable	17	45.9	9	26,5		
<3times per week <6 mos	1	2.7	1	2.9		
<3 times per week >6 mos	1	2.7	1	2.9		
>4 times a week >6mos	3	8.1	0	0		

* All spoke English conversationally >3 years
** One participant spoke English conversationally >3 years, one for 1-3 years
*** One participant in the waitlist did not answer
**** No LOC or hospitalizations reported

Table 3. 3

Descriptive Statistics of Study III Measures

	Group				
	Mindfulness Intervention		Waitlist Control		
Variable	Range	Mean (SD)	Range	Mean (SD)	Alpha
Mindfulness					
Preintervention	62-141	94.22(18.47)	57-128	97.03(16.14)	0.92
Postintervention	73-144	106.51(16.83	55-132	101.65(17.88)	0.92
Emotion regulation					
Preintervention	55-134	90.38(21.04)	53-136	85.77(22.93)	0.94
Postintervention	43-120	75.32(20.27)	51-145	85.27(23.38)	0.94
Emotional Distress					
Preintervention	0-49	18.87(13.45)	0-52	16.85(13.65)	0.93
Postintervention	0-48	14.00(11.38)	0-63	16.12(14.85)	0.93
Perceived Stress					
Preintervention	10-41	20.54(5.66)	1-32	18.65(7.12)	0.86
Postintervention	5-32	17.84(6.94)	9-35	19.59(7.35)	0.88
Negative Affect					
Preintervention	11-40	23.49(7.50)	10-37	21.53(6.63)	0.86
Postintervention	10-32	19.38(5.97)	11-48	21.68(8.77)	0.86

Positive Affect					
Preintervention	13-46	28.87(7.67)	14-46	31.03(8.18)	0.91
Postintervention	15-49	32.70(8.23)	15-44	28.32(6.87)	0.89
Psychological Flexibility					
Preintervention	7-40	22.49(8.59)	7-49	21.24(10.76)	0.92
Postintervention	7-42	17.81(8.48)	7-48	22.00(11.05)	0.92

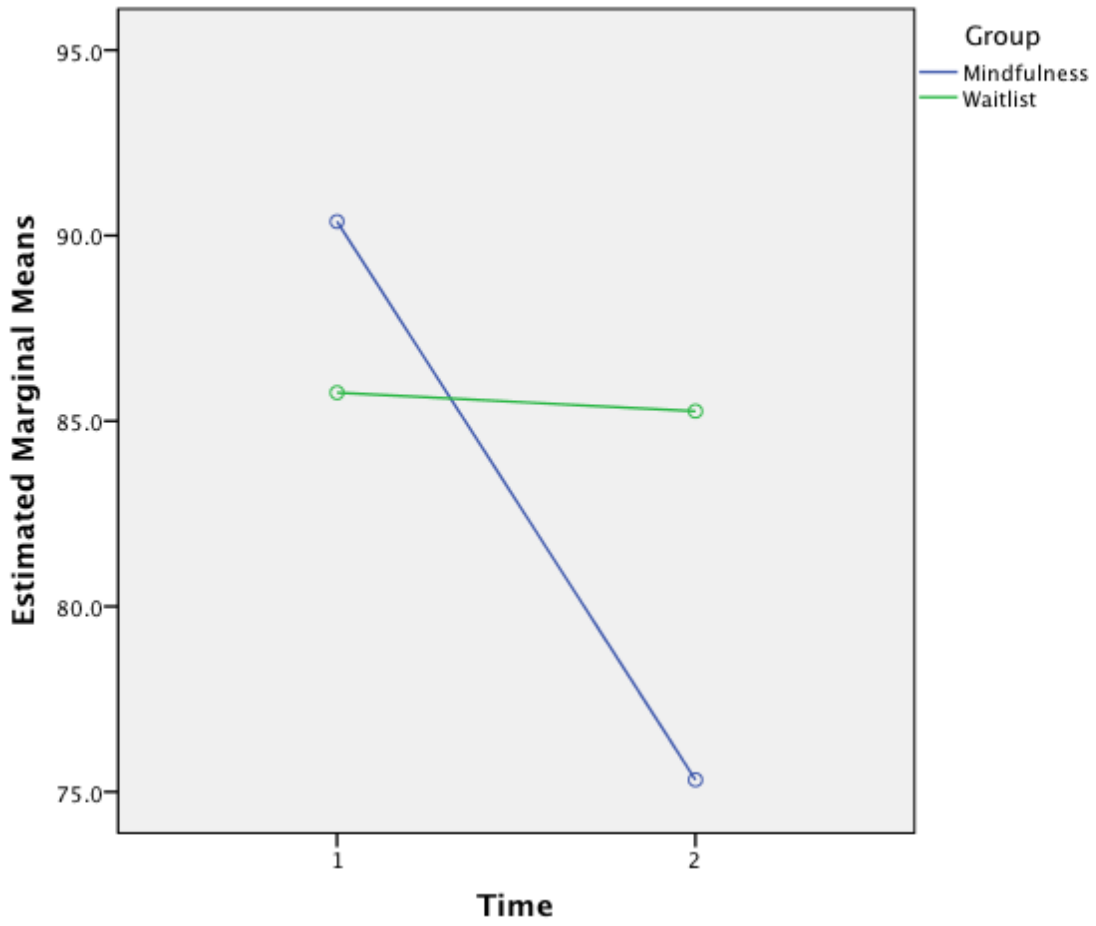

Figure 2. 1. Estimated marginal means for difficulties in emotion regulation across time.

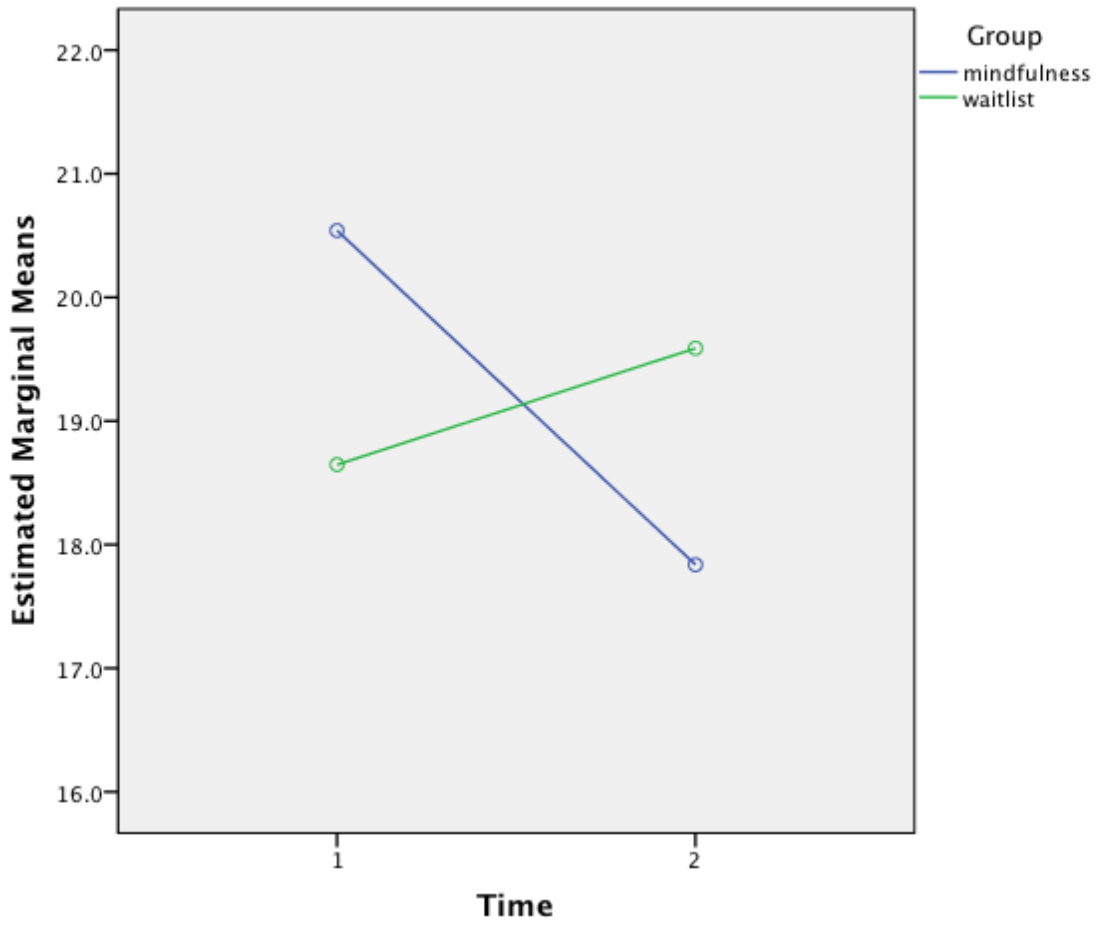

Figure 2. 2. Estimated marginal means for perceived stress across time.

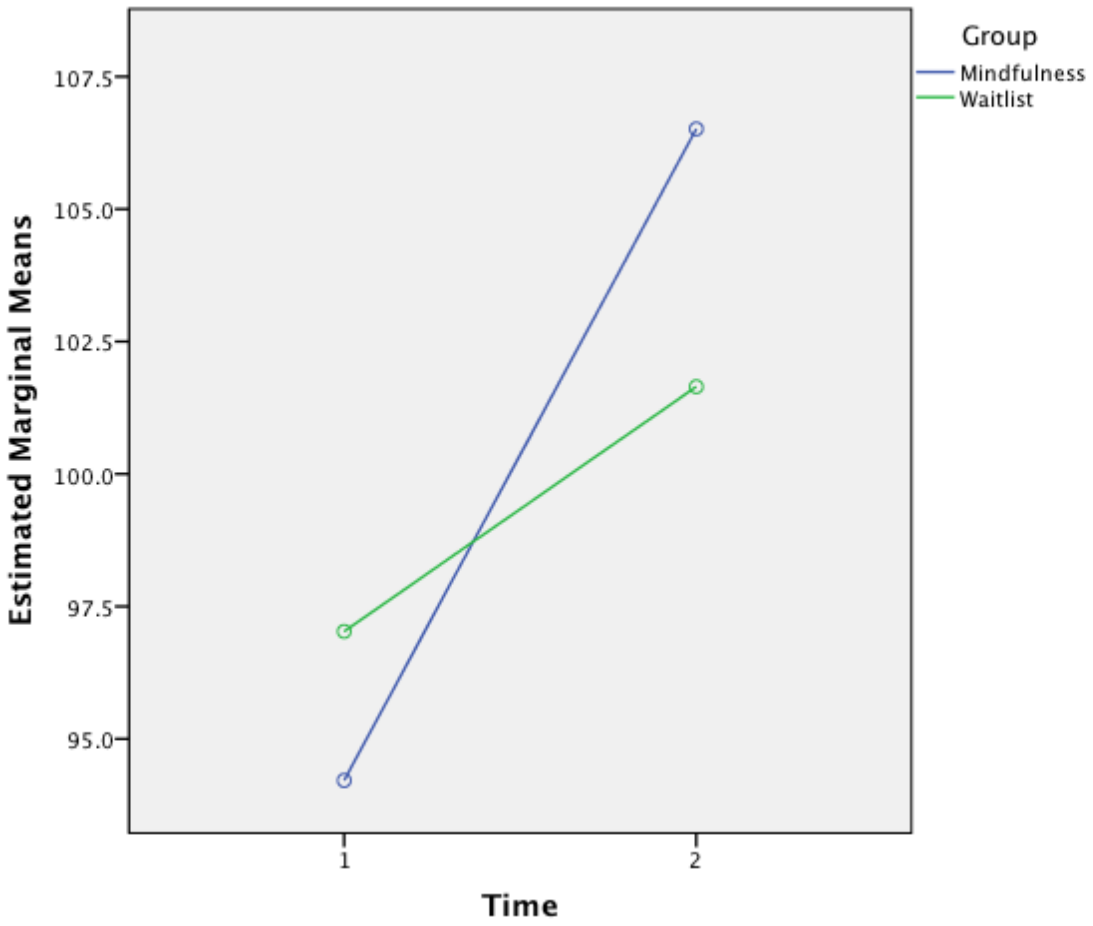

Figure 2. 3. Estimated marginal means for mindfulness across time.

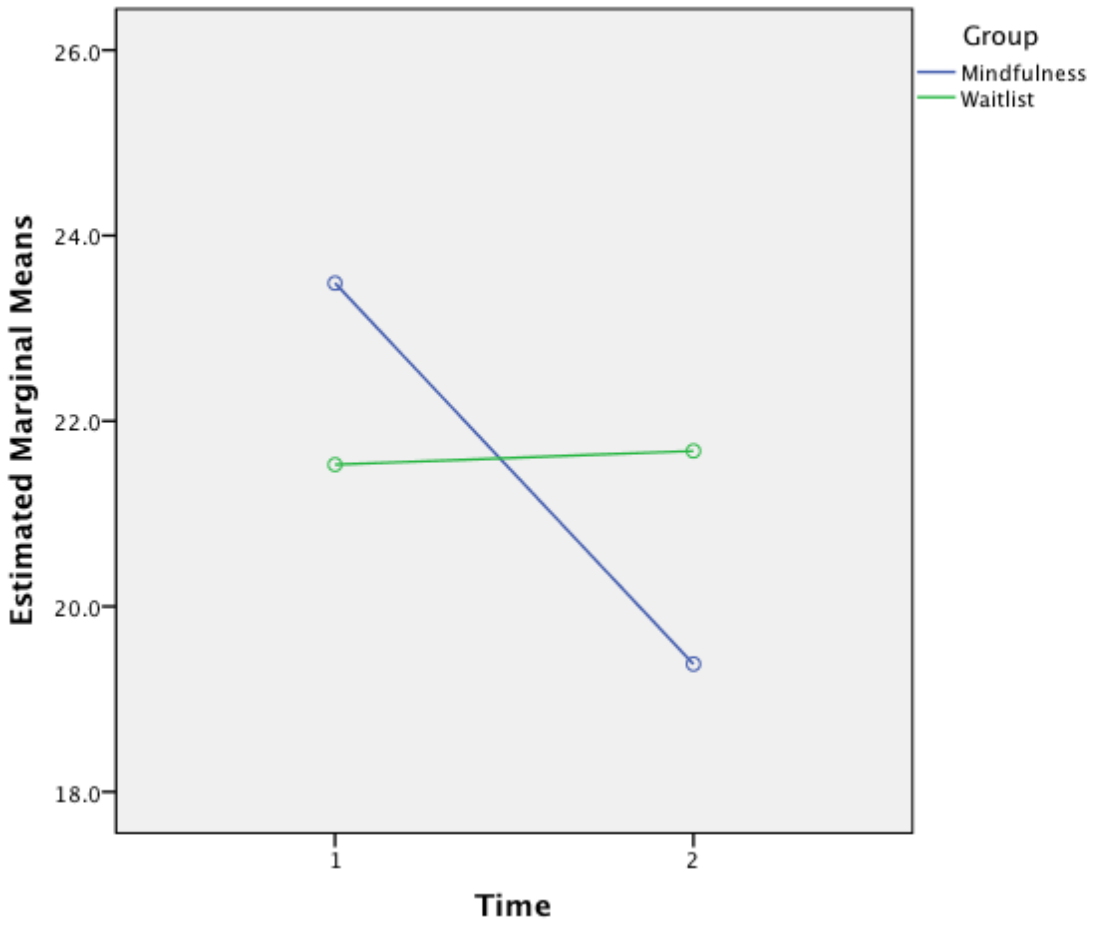

Figure 2. 4. Estimated marginal means for negative affect across time.

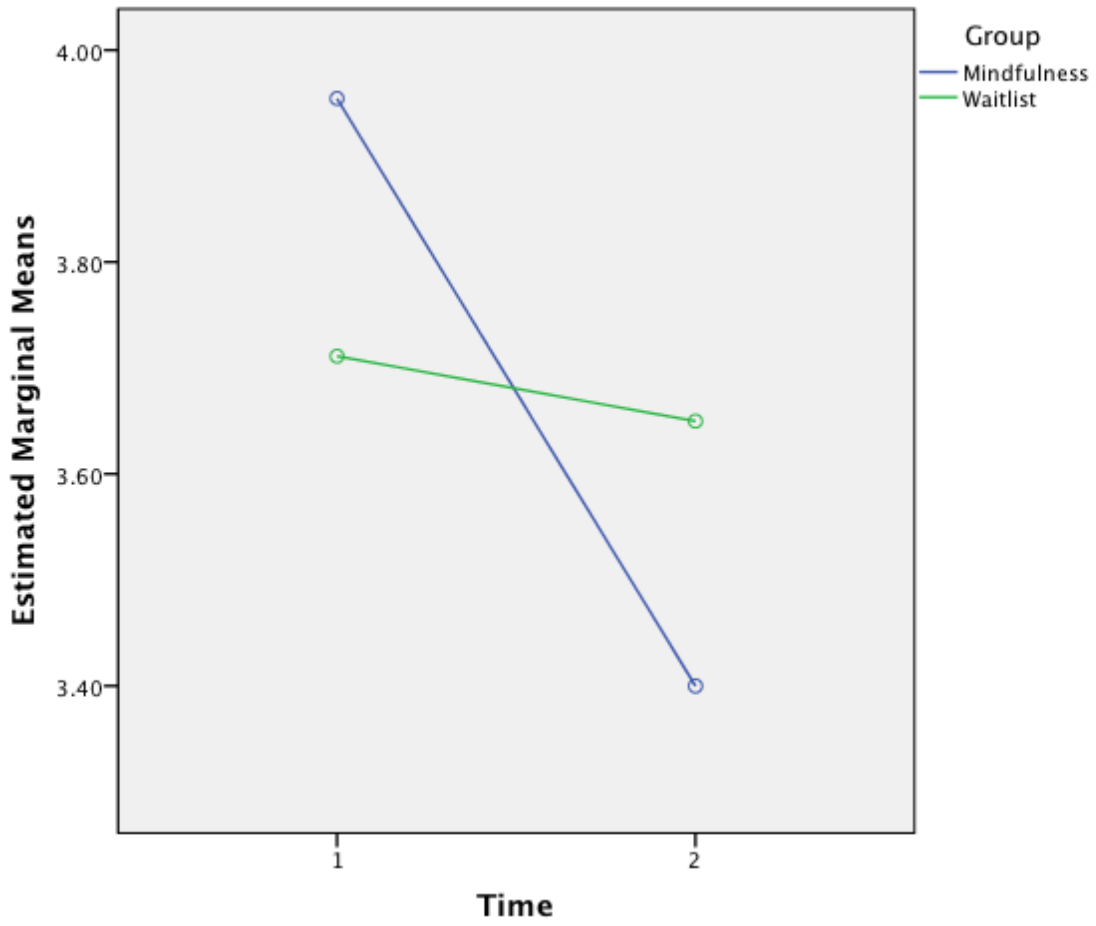

Figure 2. 5. Estimated marginal means for emotional distress across time.

Table 3. 4

Intercorrelations between Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Group	1								
Pre FFMQ	.46	1							
Post FFMQ	-.04	.05	1						
Pre AAQ	.04	-.05	-.01	1					
Post AAQ	-.13	.07	.04	-.06	1				
Pre DERS	-.16	.01	.02	-.06	-.19	1			
Post DERS	.20	.06	.13	-.12	.09	.09	1		
PANAS- PA	.09	.06	.11	-.09	.03	.04	.59**	1	
BFI- N	.08	-.19	-.01	-.02	.02	-.22*	-.68**	-.48**	1

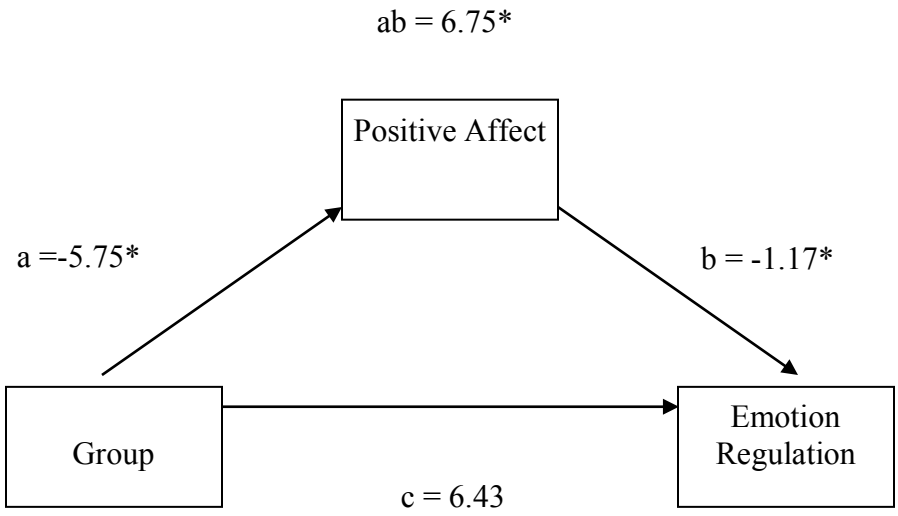

Figure 2. 6. Positive affect mediating the relationship between group and emotional regulation.

* Confidence interval does not include zero
***a = effect of X on M, b = effect of M on Y, ab = indirect effect, c = direct effect*

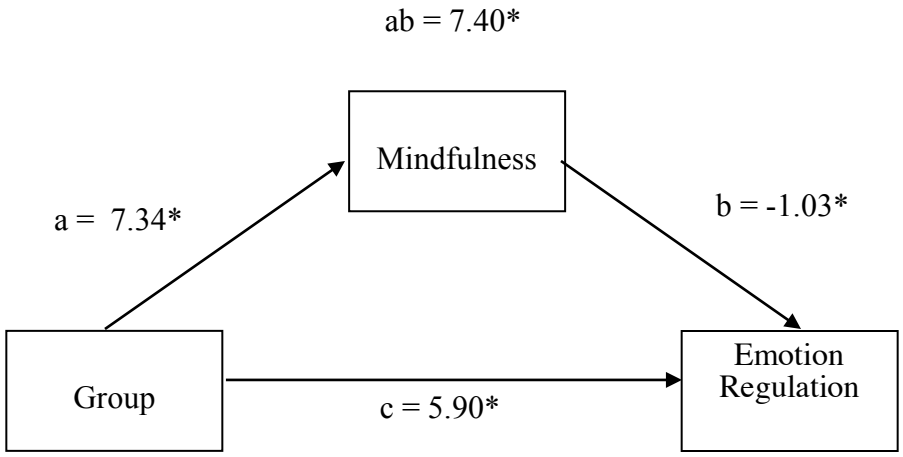

Figure 2. 7.Mindfulness mediating the relationship between group and emotion regulation.

** Confidence interval does not include zero*
*** a = effect of X on M, b = effect of M on Y, ab = indirect effect, c = direct effect*

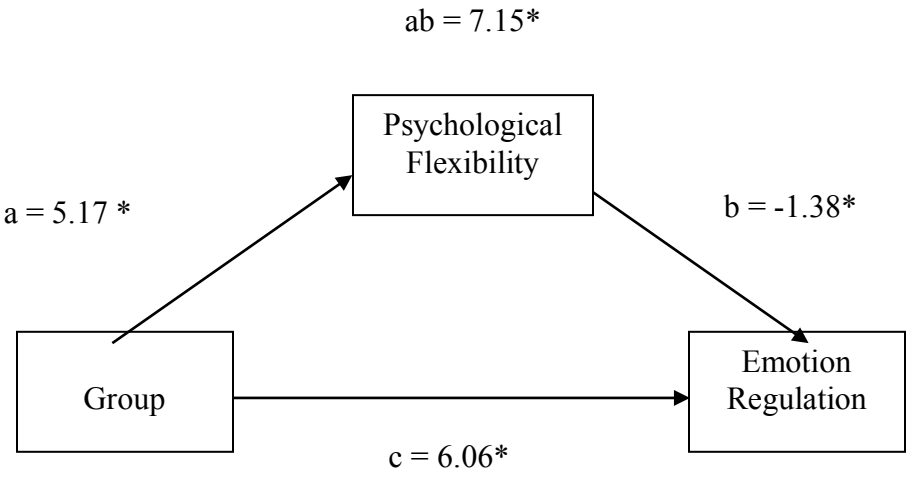

Figure 2. 8. Psychological flexibility mediating the relationship between group and emotion regulation.

** Confidence interval does not include zero*
*** a = effect of X on M, b = effect of M on Y, ab = indirect effect, c = direct effect*

Table 3. 5

Mediation Models between Group and Emotional Regulation Postintervention

Mediator	*Path*	*Coefficient*	*95% CI*	*t*	*p*
Positive Affect					
	X→M (a)	-5.76	-8.51 to -3.00	-4.18	.0001
	M → Y (b)	-1.17	-1.73 to-.61	-4.17	.0001
	Direct (c)	6.43	-.684 to 13.55	1.80	.0757
	Indirect (ab)	6.75	2.93 to 11.48		
Mindfulness					
	X→M (a)	-7.18	-12.77 to -1.59	-2.56	.0126
	M → Y (b)	-1.03	-1.20 to -0.86	-11.86	.0000
	Direct (c)	5.90	1.73 to 10.096	2.83	.0062
	Indirect (ab)	7.40	2.09 to 13.10		
Psychological Flexibility					
	X→M (a)	5.18	2.21 to 8.14	3.49	.0009
	M → Y (b)	1.38	.92 to 1.84	6.05	.0000
	Direct (c)	6.06	.04 to 12.08	2.01	.0484
	Indirect (ab)	7.15	3.34 to 11.63		

Note: X = group, M = mediator, Y = outcome (Emotion Regulation).

CHAPTER 6

General Discussion

Mindfulness-based interventions (MBIs) have been implemented successfully in a number of clinical populations, as well as with subclinical groups and psychologically healthy individuals seeking to improve general well-being (Keng et al., 2013). There is a broad literature demonstrating that traditional 8-week in-person MBIs improve psychological outcomes and emotion regulation in healthy adults and student samples (for review, see Keng et al., 2013).

Despite the documented benefits associated with MBIs, researchers and clinicians conducting mindfulness-based interventions in higher education settings cite a number of challenges with these interventions. For example, there are high attrition rates, which might be related to student complaints such as scheduling conflicts, transportation to campus, and difficulty managing the time commitment required for participation given academic obligations. Due to the broad range of benefits associated with traditional MBIs, researchers have started investigating the effects of Internet-delivered mindfulness-based interventions (ID-MBIs). It was hoped that the Internet delivery model would increase access to mindfulness programming aimed at improving well-being in a cost-effective and time-efficient manner, while reducing perceived barriers to treatment, such as stigma, limited availability, and conflicting schedules. It is posited that online programs for student mental wellness may reach a larger number of students at a lower cost, thereby reducing barriers to treatment (Eisenberg, Lipson, & Posselt, 2016). This is particularly important for students in higher education who report higher levels of

distress than their nonuniversity peers and seek help less readily (Blanco et al., 2008; Macaskill, 2012; Ontario College Health Association, 2009).

Preliminary work investigating mindfulness interventions delivered online to students in higher education have shown reductions in stress (Messer, Horan, Turner, & Weber, 2016; Cavanaugh, 2013), self-report symptoms of anxiety and depression (Cavanaugh, 2013), and improved mental well-being (Mak et al., 2015) and increased mindfulness (Cavanaugh, 2013). However, some have not replicated these significant findings with regard to perceived stress or psychological symptoms (Mak et al., 2015). In summation, a small body of evidence suggests that ID-MBIs may offer benefits for university students; however, results have been mixed and these studies have focused largely on stress, depression, and anxiety.

Building on the extant literature, the aim of the current three-study project was to determine the feasibility of an internet-delivered mindfulness-based intervention (ID-MBI) for university students and assess outcomes related to general well-being and coping such as emotion regulation and psychological flexibility. This is in line with transdiagnostic approaches in the prevention and treatment of mental health disorders. As such, the goal of the first study was to assess compliance with the intervention via self-reported daily , self-reported retrospective, and computer-timed -objective measures of compliance to compare the reliability of such measures to determine if a more objective measure of compliance could be established for this type of Internet-delivered intervention. The goal of the second study was to assess various factors that might impact postintervention levels of mindfulness, such as personality factors (i.e., neuroticism and conscientiousness) in addition to compliance to the intervention. Finally, the third study

aimed to determine if the intervention improved emotion regulation, reduced psychological distress and reduced perceived stress as compared to a waitlist-control group. Additionally, the study investigated whether increases in positive affect, psychological flexibility, and mindfulness served as mechanisms of change.

Thematic Results

Reliability of self-report and computer-timed measures of compliance.

Previous work investigating the impacts on compliance with home practice (i.e., time spent practicing mindfulness) and clinical outcomes is equivocal. Research suggests only partial support for the relationship between practice time and clinical outcomes (Vettese et al., 2009). Further, few studies have investigated the association of home practice and reported changes in mindfulness, and these findings are similarly equivocal (Vettese et al., 2009).

The standard for assessing compliance is self-report measures, and there is significant heterogeneity even within self-report measures (e.g., retrospective, daily , weekly). Self-report measures of compliance may be unreliable given a potential for bias or exaggeration (Kazantzis, Deane, & Ronan, 2004), such as the halo-effect and biases related to subjective emotional experience or perceived changes from the intervention (Bryant et al. 1999; Kazantzis, Ronan & Deane, 2001; Thase & Callan, 2006). Additionally, findings may be impacted by the source and timing of rating (Mausbach, 2010). This study attempted to clarify the relationship between various measures of compliance and to develop a novel computer-timed measure of compliance via program usage. Contrary to previous work (e.g., Mausbach, 2010), participants were consistent in reporting compliance at daily and retrospective time points and they showed a high

degree of reliability. The computer-timed measure was more conservative and suggested a slight tendency to over-report; however, the computer-timed measure was still fairly consistent with retrospective report of compliance. It could be that participants over-report compliance less than previously thought, or that participants more accurately reported compliance given that they knew the researchers were obtaining their assignments through the program. Accurately assessing compliance may help determine if compliance is related to treatment outcomes, and help facilitate future research with regard to time and quality of homework compliance. This finding adds valuable information to the MBI literature, but also psychotherapeutic literature as a whole. This finding suggests that participants in intervention research may be more accurate reporters of compliance than previously thought. Additionally, the findings suggest that homework compliance may be compared across studies, despite the wide variety in type and timing of self-report measures implemented (i.e., retrospective, prospective).

Factors that predict postintervention mindfulness. Previous work has been mixed with regard to the relation between time spent practicing and changes on measures of mindfulness. Some studies have shown significant relations (Carmody & Baer, 2008; Schenström, Ronnberg, & Bodlund, 2006) whereas other research that demonstrated that after accounting for age and baseline mindfulness scores, the duration of self-reported practice did not predict postintervention mindfulness (Manuel, Somohano, & Bowen, 2017). My project sought to clarify these relations by using the computer-timed measure of homework compliance to more accurately represent time spent practicing mindfulness skills. Time spent practicing mindfulness did not predict changes in mindfulness postintervention. This is an important finding because the actual time spent practicing has

been clinically posited as one of the most important factors related to outcome in MBIs. This finding suggests that it may not be necessary for participants to complete 45-minutes of homework every day, as suggested in traditional MBIs, to benefit. Individuals in the mindfulness group who were more conscientious regardless of time spent practicing, reported greater improvements in mindfulness postintervention. This could be because conscientious participants engaged more with other psychoeducational material leading to better quality practice or transferred the skills more into day-to-day life leading to better outcomes. Understanding personality variables that may be related to outcomes in ID-MBIs is important for predicting response to treatment and provides therapists or providers of ID-MBI with valuable information about characteristics that may make participants more likely to need monitoring and additional supports. Overall, group membership (i.e., waitlist vs. ID-MBI) more accurately predicted mindfulness postintervention than time spent practicing, such that those in the MBI group reported higher levels of mindfulness than those in the waitlist group, suggesting that there may be another active component of the program driving change, above and beyond the time spent practicing mindfulness skills, such as quality of practice.

Impact of ID-MBI on emotional distress, affect, perceived stress, and emotion regulation. As previously mentioned, newly emerging evidence suggests that ID-MBIs may offer benefits for university students; however, results have been mixed. My findings provide support for and further clarification of the efficacy of ID-MBIs for university students. The present study clarified that the intervention reduced perceived stress as compared to waitlist-control group, which has been shown in previous work to have similar effect sizes to in-person mindfulness training (Spijkerman et al., 2016). The

study did not find support for the reduction of emotional distress, which has been mixed in the literature (Spijkerman et al., 2016). This may be because the university sample was largely nonclinical, and therefore there was limited variability in their self-reported psychological symptoms or the results may be related to the nature of MBIs more broadly. MBIs follow a transdiagnostic model for intervention that is focused on observing experiences and internal states and are not focused on reducing specific symptoms (Bishop, 2002; Kabat-Zinn, 2003).

The present study was the first to assess the impacts of ID-MBI on emotion regulation and affect. The intervention group reported significant improvements in emotion regulation and decreases in negative affect as compared to the control group. Taken together, this supports the use of ID-MBIs for higher education students who are seeking ways to improve coping and reduce stress. This ID-MBI is a cost effective and feasible option for students seeking strategies to improve general well-being and coping in a way that reduces barriers to traditional psychotherapeutic interventions.

Mechanisms of change. Identifying mechanisms of change in psychotherapeutic interventions has several important implications, such as improving intervention effectiveness, by enhancing the active components of the treatments (Kazdin, 2007). Previous work has identified several possible mechanisms of change in MBI. Changes in mindfulness are the most theorized (Kabat-Zinm, 1982; Segal et al., 2002) and well-supported mechanism of change within MBIs (Gu et al., 2015). Meta-analyses revealed that mindfulness significantly mediated the effects of traditional MBIs on diverse mental health outcomes (e.g., stress, depression, anxiety; Gu et al., 2015) across a number of populations (e.g., adults with depression, anxiety disorders, nonclinical samples; Gu et

al., 2015). A narrative review of the literature also identified emotional processes to have moderate, consistent evidence for mediation effects in MBIs; however, findings have been somewhat equivocal in various clinical and subclinical populations (van Aalderen et al., 2012; Batink et al., 2013). Lastly, there is preliminary but insufficient evidence to support psychological flexibility as a mechanism of change in MBIs at the present time (Gu et al., 2015).

In line with research highlighting mindfulness, psychological flexibility, and affectivity as possible mechanisms of change, was the finding that increases in these variables postintervention predicted improvement in emotion regulation skills. All three variables accounted for a significant amount of variation in postintervention emotion regulation. The need to examine mechanisms of change in mindfulness-based interventions is important, especially for Internet-delivered interventions, to determine ways to target specific constructs to improve efficacy. The identified mechanisms of change highlight that this online intervention may not only be beneficial for individuals reporting symptoms of distress, but also could be implemented with healthy and at-risk students, as mindfulness, psychological flexibility, and positive affect have all been shown important for general health and well-being (e.g., Cieslak, et al., 2016; Kashdan & Rottenberg, 2010). Thus, implementing ID-MBIs within higher education institutions could be an effective and feasible program option for promoting mental health awareness and targeting at-risk students.

Overall Limitations

The overall study should be considered within the context of its limitations. First, the sample was restricted to a departmental research pool with the majority of the sample

being individuals who identified as female, potentially reducing the generalizability of the results. However, university populations have been frequently targeted in testing the feasibility of ID-MBIs, given their high rates of attrition in traditional MBIs. Future work may consider focusing on implementing the intervention in more diverse groups.

Second, the study relied heavily on self-report data introducing common-methods variance. However, self-report is the most common and widely available means to assess an individual's internal states that are not easily observed by others. The study attempted to create a novel computer-timed -measure of compliance to the intervention in order to more accurately assess compliance to the intervention, which have shown to be biased by participant recall and mood in other research (Bryant et al., 1999; Kazantzis, Ronan & Deane, 2001; Thase & Callan, 2006).

Third, the study implemented a waitlist-randomized control design, to improve upon previous research investigating Internet-delivered mindfulness-based interventions, in which many studies have implemented pre- and post-design. However, it would be valuable to conduct randomized control trials using treatment as usual or an active control to further support and strengthen the current findings.

Implications for Higher Education

Overall, the results of the study suggest that a brief ID-MBI can be implemented in higher education institutions to improve general well-being in university students. The program reduced perceived stress and negative affect, and improved factors important to general well-being such as emotion regulation, psychological flexibility, and positive affect. The drop-out rate for university students in the mindfulness program was relatively low (i.e., 13.5%). A common suggestion for improvement was the development

of a smartphone application to improve convenience and access. The efficacy of this should be the focus of future research projects.

Emotion regulation, psychological flexibility, and mental health are outcomes related to academic engagement and retention (Eisenberg, 2016). Therefore, results from the current study support the provision of mindfulness programming to post-secondary students as universities seek to improve general wellbeing, resiliency, and retention in their student population. Further, it has wide-scale applicability that may serve to reduce potential barriers to more traditional mindfulness skill training programs that are offered in-person (e.g., monetary burden, transportation, and childcare). It may be a feasible and cost- and time-efficient program that may be implemented within educational institutions seeking to offer programming focused on improving valued educational outcomes and the well-being of their students.

Conclusion

The results of these three studies provided support for the utility and effectiveness of a brief online mindfulness intervention for university students. The intervention reduced negative affect and perceived stress, and improved participants' mindfulness and emotion regulation skills as compared to the waitlist-control group. The intervention improved emotion regulation through several mechanisms of change, including increases in positive affect, psychological flexibility, and mindfulness. The drop-out rate for the intervention was approximately 13%, suggesting that online treatment may be a feasible option to reduce some barriers to perceived treatment in higher education. Despite the development of a more conservative computer-timed measure of homework compliance, this study suggests that the raw time spent practicing mindfulness may not be the active

ingredient leading to changes in mindfulness, and perhaps quality of practice should be considered in future research.

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Appendices

Appendix A

CONSENT TO PARTICIPATE IN RESEARCH – MINDFULNESS INTERVENTION

Title of Study: Is your mind full? Learn to manage stress and improve emotional well-being through an Internet-delivered mindfulness intervention.

You are asked to participate in a research study conducted by Molly Cairncross M.A., and Carlin Miller, Ph.D., from the Psychology Department at the University of Windsor. The results of this study will contribute to Molly Cairncross' dissertation work. If you have any questions or concerns about the research, please feel to contact Dr. Carlin Miller at (519) 253-3000 ext. XXXX.

PURPOSE OF THE STUDY

Research examining the impacts of mindfulness-based interventions on psychological well-being have found it to be effective at improving psychological outcomes and emotional well-being in healthy adults and student samples. Therefore, Internet-delivered mindfulness-based interventions have been developed in order to determine if these online interventions provide similar benefits. We hope that this research will help us provide accessible and cost-free programming to promote the health and well-being of university students

Questionnaire responses and data from research tasks (but not identifying participant information) collected in this project may also be stored securely (on an encrypted, password-protected USB drive) for future use.

PROCEDURES

If you volunteer to participate in this study, you will be asked to:

1. **Give consent** to participate in this study after reading this form and asking any questions you may have.
2. **Complete a series of questionnaires**. Each of the questionnaires will ask a different type of question. Many of the questions will ask about how you usually think, feel, and act.
   - You may skip a question or questions if you feel uncomfortable or would not like to answer.
   - You may also withdraw from the study if you wish to quit.
   - In total, it is expected that this portion of the study will take you about 1.5 hour (90 minutes) to complete.
3. **Fill out a course credit sheet.** This paper will have your personal information on it so that you can receive course credit for participating. We collect this personal information on paper, so that your questionnaire data and information about your participation with the intervention will not be linked to you. This sheet will be stored securely with your consent form.

4. **Participate in the online intervention for 4-weeks**. You will be shown how to access the intervention and helped to register your user login and password. It is asked that participants practice 10 minutes a day for the four weeks.
5. **Complete a series of questionnaires**. Each of the questionnaires will ask a different type of question. Many of the questions will ask about how you usually think, feel, and act.
   - You may skip a question or questions if you feel uncomfortable or would not like to answer.
   - You may also withdraw from the study if you wish to quit.
   - In total, it is expected that this portion of the study will take you about 1.0 hour (60 minutes) to complete.

POTENTIAL RISKS AND DISCOMFORTS

There are no expected physical, financial, or social risks associated with participating in this study. The psychological and emotional, risks of participating are, at most, low. Although some questions ask for sensitive information (e.g., medical history), we will never link your data to your identifying information (e.g., name, email address, UWindsor ID). Additionally, any demographic data (e.g., gender, age, program of study) will be stored separate from your responses to other questions. Therefore, there is low risk that your responses will be linkable to you. Additionally, responses to such questions are voluntary, and data will be held strictly confidential and will not be made accessible to anyone outside of the study team.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

By participating in this study, you will gain first-hand knowledge about the research process. Thinking about answers to the questionnaire items may also lead to a greater sense of self-awareness. Your participation in this study is also important for the scientific community. This research will help to determine if this online intervention improves well-being in university students, providing students with a cost-efficient and time-efficient program to improve psychological health and well-being.

COMPENSATION FOR PARTICIPATION

As per the guidelines set by the Psychology Participant Pool, compensation for participation will be provided with bonus points. As per participant pool regulations, no more than 3.0 bonus points can be provided to pool participants for one study. Participants who complete the first series of questionnaires will receive 1.5 bonus points. You will then have access to the free and unlimited guided mindfulness intervention for four weeks. Once you complete the second series of questionnaires after using the intervention for four weeks, you will be assigned an additional 1.5 points. As such, those who complete all phases will be eligible to receive up to 3.0 bonus points.

CONFIDENTIALITY

No information will be obtained that may connect your identity to your responses. For the purposes of assigning course credit and documenting the number of credits you have earned, your name, student ID number, and email address will be collected. However, this information will be collected separately from the data you provide on measures used in this study. This sheet will be securely stored with your consent form and will be kept strictly confidential (i.e., will only be accessible to the research team). These forms will be securely stored for one year after completion of data collection; after this point, they will be securely destroyed.

In addition to ensuring that no link will exist between your identity and the information you provide during this study, the researchers will ensure that all data are held strictly confidential and will not be accessible to anyone outside of the research team. Additionally, although Dr, Miller serves as a faculty supervisor for this project, she will not have access to information regarding who participated in this study in order to protect the identities of any students for whom she is an instructor. Questionnaire data you provide will be initially securely stored on campus at the University of Windsor in a locked office that is only accessible to the research team. Data provided on the online intervention will be securely stores on the principal investigators secure server, After you complete the study, all data will be transferred to a secure, encrypted, password-protected USB drive and deleted from the server, and any demographic data you provide (e.g., your gender, ethnic background, program of study) will be stored separately from your questionnaire responses. A second USB drive will exist as a back-up of collected data and will be kept in the possession of the research supervisor (Dr. Carlin Miller). These USB drives will be kept secure when not in use.

Data collected from this study will be analysed at a group level. Only group-level results will be published in the final dissertation and other publications/presentations. Your responses will not be shared individually.

PARTICIPATION AND WITHDRAWAL

Participation in this study is voluntary. You may choose to omit a question(s) if you choose. If you wish to withdraw from the study, you may do so without consequences at any time before completing the study and submitting your responses by tell the primary investigator. You will be awarded course credit in accordance with the amount of time spent in the study (30 minutes = .5 credits), per participant pool policy. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE PARTICIPANTS

The results of this study will be available on the University of Windsor's Research Ethics Board website:

Web address: http://www1.uwindsor.ca/reb/study-results

Date when results are available: December, 2018

SUBSEQUENT USE OF DATA

These data may be used in subsequent studies, in publications and in presentations.

RIGHTS OF RESEARCH PARTICIPANTS

If you have questions regarding your rights as a research participant, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario, N9B 3P4; Telephone: 519-253-3000, ext. 3948; email: ethics@uwindsor.ca

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I understand the information provided for the study **"**Is your mind full? Learn to manage stress and improve emotional well-being through an Internet-delivered mindfulness intervention" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____

Name of Participant

_____ _____

Signature of Participant Date

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research.

_____ _____

Signature of Investigator Date

CONSENT TO PARTICIPATE IN RESEARCH – WAITLIST

Title of Study: Is your mind full? Learn to manage stress and improve emotional well-being through an Internet-delivered mindfulness intervention.

You are asked to participate in a research study conducted by Molly Cairncross M.A., and Carlin Miller, Ph.D., from the Psychology Department at the University of Windsor. The results of this study will contribute to Molly Cairncross' dissertation work. If you have any questions or concerns about the research, please feel to contact Dr. Carlin Miller at (519) 253-3000 ext. XXXX.

PURPOSE OF THE STUDY

Research examining the impacts of mindfulness-based interventions on psychological well-being have found it to be effective at improving psychological outcomes and emotional well-being in healthy adults and student samples. Therefore, Internet-delivered mindfulness-based interventions have been developed in order to determine if these online interventions provide similar benefits. We hope that this research will help us provide accessible and cost-free programming to promote the health and well-being of university students.

Questionnaire responses and data from research tasks (but not identifying participant information) collected in this project may also be stored securely (on an encrypted, password-protected USB drive) for future use.

PROCEDURES

You have been selected to participate in a waitlist control group for the current study. If you volunteer to participate in this study, you will be asked to complete a series of questionnaires at two different time points (Procedures 1-5), whether you choose to participate in the intervention after is completely optional (procedures 6-7):

1. **Give consent** to participate in this study after reading this form and asking any questions you may have.
2. **Complete a series of questionnaires**. Each of the questionnaires will ask a different type of question. Many of the questions will ask about how you usually think, feel, and act.
   - You may skip a question or questions if you feel uncomfortable or would not like to answer.
   - You may also withdraw from the study if you wish to quit.
   - In total, it is expected that this portion of the study will take you about 1.5 hours (90 minutes) to complete.
3. **Fill out a course credit sheet.** This paper will have your personal information on it so that you can receive course credit for participating. We collect this personal information on paper, so that your questionnaire data and information about your participation with the intervention will not be linked to you. This sheet will be stored securely with your consent form.

4. **Four weeks without active participation**. You will not have to participate in any additional research activities for four weeks. After four weeks you will be asked to come back into the lab to complete additional questionnaires.
5. **Complete a series of questionnaires**. Each of the questionnaires will ask a different type of question. Many of the questions will ask about how you usually think, feel, and act.
   - You may skip a question or questions if you feel uncomfortable or would not like to answer.
   - You may also withdraw from the study if you wish to quit.
   - In total, it is expected that this portion of the study will take you about 1.0 hours (60 minutes) to complete.
6. **Receive the four week Internet-delivered mindfulness based intervention.** You will be shown how to access the intervention and helped to register your user login and password. At this point you can decide to continue research participating by completing the intervention and returning to

the lab to complete another series of questionnaires (7a. OR you may obtain the intervention and decide not to participate in any additional research. This decision is at the discretion of the participant and no adverse/negative consequences occur based on this choice. Participants will receive full credit regardless of this decision. .

7. Choose one of the following options:
    a. **Complete a series of questionnaires**. Each of the questionnaires will ask a different type of question. Many of the questions will ask about how you usually think, feel, and act.
        - You may skip a question or questions if you feel uncomfortable or would not like to answer.
        - You may also withdraw from the study if you wish to quit.
        - In total, it is expected that this will take you about 1.0 hours (60 minutes) to complete.
        - Snacks and beverages will be provided to acknowledge your additional time
    b. **No further research contact.** Have access to complete the intervention in a self-guided manner (no further contact with the researcher) and without completing any additional questionnaires.

POTENTIAL RISKS AND DISCOMFORTS

There are no expected physical, financial, or social risks associated with participating in this study. The psychological and emotional, risks of participating are, at most, low. Although some questions ask for sensitive information (e.g., medical history), we will never link your data to your identifying information (e.g., name, email address, UWindsor ID). Additionally, any demographic data (e.g., gender, age, program of study) will be stored separate from your responses to other questions. Therefore, there is low risk that your responses will be linkable to you. Additionally, responses to such questions are voluntary, and data will be held strictly confidential and will not be made accessible to anyone outside of the study team.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

By participating in this study, you will gain first-hand knowledge about the research process. Thinking about answers to the questionnaire items may also lead to a greater sense of self-awareness. Your participation in this study is also important for the scientific community. This research will help to determine if this online intervention improves well-being in university students, providing students with a cost-efficient and time-efficient program to improve psychological health and well-being.

COMPENSATION FOR PARTICIPATION

As per the guidelines set by the Psychology Participant Pool, compensation for participation will be provided with bonus points. As per participant pool regulations, no more than 3.0 bonus points can be provided to pool participants for one study. Participants who complete the first series of questionnaires will receive 1.5 bonus points. Once you complete the second series of questionnaires after the four weeks, you will be assigned an additional 1.5 points. As such, those who complete all phases will be eligible to receive up to 3.0 bonus points. You will then have the opportunity to complete the intervention (optional) and return for another follow-up series of questionnaires, at which time there will be a variety if snacks and beverages to acknowledge your additional time.

CONFIDENTIALITY

No information will be obtained that may connect your identity to your responses. For the purposes of assigning course credit and documenting the number of credits you have earned, your name, student ID number, and email address will be collected. However, this information will be collected separately from the data you provide on measures used in this study. This sheet will be securely stored with your consent form and will be kept strictly confidential (i.e., will only be accessible to the research team). These forms will be securely stored for one year after completion of data collection; after this point, they will be securely destroyed.

In addition to ensuring that no link will exist between your identity and the information you provide during this study, the researchers will ensure that all data are held strictly confidential and will not be accessible to anyone outside of the research team. Additionally, although Dr, Miller serves as a faculty supervisor for this project, she will not have access to information regarding who participated in this study in order to protect the identities of any students for whom she is an instructor. Questionnaire data you provide will be initially securely stored on campus at the University of Windsor in a locked office that is only accessible to the research team. Data provided on the online intervention will be securely stores on the principal investigators

secure server, After you complete the study, all data will be transferred to a secure, encrypted, password-protected USB drive and deleted from the server, and any demographic data you provide (e.g., your gender, ethnic background, program of study) will be stored separately from your questionnaire responses. A second USB drive will exist as a back-up of collected data and will be kept in the possession of the research supervisor (Dr. Carlin Miller). These USB drives will be kept secure when not in use.

Data collected from this study will be analysed at a group level. Only group-level results will be published in the final dissertation and other publications/presentations. Your responses will not be shared individually.

PARTICIPATION AND WITHDRAWAL

Participation in this study is voluntary. You may choose to omit a question(s) if you choose. If you wish to withdraw from the study, you may do so without consequences at any time before completing the study and submitting your responses by tell the primary investigator. You will be awarded course credit in accordance with the amount of time spent in the study (30 minutes = .5 credits), per participant pool policy. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE PARTICIPANTS

The results of this study will be available on the University of Windsor's Research Ethics Board website:

Web address: http://www1.uwindsor.ca/reb/study-results

Date when results are available: December, 2018

SUBSEQUENT USE OF DATA

These data may be used in subsequent studies, in publications and in presentations.

RIGHTS OF RESEARCH PARTICIPANTS

If you have questions regarding your rights as a research participant, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario, N9B 3P4; Telephone: 519-253-3000, ext. 3948; email: ethics@uwindsor.ca

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I understand the information provided for the study **"**Is your mind full? Learn to manage stress and improve emotional well-being through an Internet-delivered mindfulness intervention" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____

Name of Participant

_____ _____

Signature of Participant Date

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research.

_____ _____

Signature of Investigator Date

Appendix B

DEMOGRAPHIC INFORMATION

Date of Birth (MM/YY): ___/___ Age (years): ____

GENDER:
- [1] FEMALE
- [2] MALE
- [3] OTHER (specify):
- [4] PREFER NOT TO ANSWER

Race/ethnic background:
- [1] ABORIGINAL
- [2] ASIAN OR ASIAN DESCENT (NON-ARAB)
- [3] HISPANIC/LATINO
- [4] NON-HISPANIC BLACK OR AFRICAN DESCENT
- [5] NON-HISPANIC WHITE, CAUCASIAN, OR EUROPEAN DESCENT
- [6] ARAB OR MIDDLE-EASTERN DESCENT
- [7] OTHER/MIXED (please describe) _____
- [8] PREFER NOT TO ANSWER

Is English your primary language? [1] Yes [2] No

If No, how many years have you spoken English conversationally?
- [1] less than 1 year
- [2] 1-3 years
- [3] more than 3 years

Please describe your current level of employment, outside of being a student:
- [1] Full-time (including volunteer work)
- [2] Part-time (including volunteer work)
- [3] Not currently employed or volunteering

ACADEMIC HISTORY

Please indicate your year at UWindsor:
- [1] 1st year
- [2] 2nd year
- [3] 3rd year
- [4] 4th year
- [5] 5th year or beyond
- [6] Graduate student (specify year, program): _____

To which academic faculty do you belong?

[1] Faculty of Arts, Humanities and Social Sciences
[2] Faculty of Science
[3] Faculty of Business Administration
[4] Faculty of Education
[5] Faculty of Engineering
[6] Faculty of Human Kinetics
[7] Faculty of Nursing

Overall GPA:
[1] below 60
[2] 60-70
[3] 70-80
[4] 80 or above

MEDICAL HISTORY
Are you currently participating in psychotherapy or counseling (i.e., with a therapist or psychologist)
[1] Yes
[2] No

Have you participated in psychotherapy or counselling in the past?
[1] Yes
[2] No
[3] Prefer not to answer

Have you ever experienced a traumatic brain injury? [1] Yes [2] No
If yes, did you lose consciousness (i.e., get knocked out): [1] Yes [2] No
If yes, were you hospitalized and if so, for how long? Please describe:
_____
_____

Have you ever been diagnosed with a neurological disorder (e.g., multiple sclerosis, stroke):
[1] Yes, please specify: _____
[2] No

EXPERIENCE WITH MINDFULNESS
Indicate your level of experience with mindfulness or other meditation practices, including yoga and other movement practices, other forms of meditation, devotional practice that is contemplative, and psychotherapy involving mindfulness:
[1] No experience
[2] Highly variable (e.g., some weeks you go to one 1 yoga class, some weeks you go to 8 yoga classes, sometimes you meditate at home)
[3] 3 or fewer times per week every week for 6 months or less
[4] 4 or more times per week for less than 6 months

[5] 3 or fewer times per week every week for more than 6 months
[6] 4 or more times per week every week for more than 6 months

Appendix C

CLIENT SATISFACTION QUESTIONNAIRE (adapted for use in ID-MBI)

Please help us improve our program by answering some questions about the services you have received. We are interested in your honest opinions, whether they are positive or negative. *Please answer all of the questions.* We also welcome your comments and suggestions. Thank you very much; we really appreciate your help.

Circle your answer:

1. In an overall, general sense, how satisfied are you with the program you received?

4	3	2	1
Very satisfied	Mostly satisfied	Indifferent or mildly dissatisfied	Quite dissatisfied

2. To what extent has our program met your needs?

4	3	2	1
Almost all of my needs have been met	Most of my needs have been met	Only a few of my needs have been met	None of my needs have been met

4. Would you recommend our program to someone else?

1	2	3	4
No, definitely not	No, I don't think so	Yes, I think so	Yes, definitely

5. How satisfied are you with the amount of help you have received?

1	2	3	4
Quite dissatisfied	Indifferent or Mildly	Mostly satisfied	Very satisfied

6. Has the program been helped you to deal more effectively with your problems?

4	3	2	1
Yes, it helped a great deal	Yes, it helped	No, it really didn't help	No, it seemed to make things worse

8. Would you use this program again?

1	2	3	4
No, definitely not	No, I don't think so	Yes, I think so	Yes, definitely

9. Will you continue to practice mindfulness skills?

1	2	3	4
No, definitely not	No, I don't think so	Yes, I think so	Yes, definitely

10. Was the program content engaging?

1	2	3	4
No, definitely not	No, I don't think so	Yes, I think so	Yes, definitely

Thank you for participating in this study! We would appreciate hearing from you, so please let us know about your experience.

Comments (e.g., what would you change about the program, what might keep you more engaged):

Appendix D

Homework Practice Form

1. How many minutes, on average, did you practice each day during the first week of the intervention? _____
    a. How many days in the first week did you practice?_____
2. How many minutes, on average, did you practice each day during the second week of the intervention?
    a. How many days in the second week did you practice?____
3. How many minutes, on average, did you practice each day during the third week of the intervention?_____
    a. How many days in the third week did you practice?_____
4. How many minutes, on average, did you practice each day during the fourth week of the intervention?_____
    a. How many days in the fourth week did you practice?_____
5. How many minutes a day, on average, did you spend listening to the audio-recorded mindfulness exercises in minutes over the last four weeks? _____
    a. How many days did you practice over the four weeks?_____

Appendix E
Crisis & Counseling Resources

If you are in crisis and need immediate assistance, please contact the Community Crisis Centre at Windsor Regional Hospital:

- 24 hour Crisis Telephone Line at (519) 973-4435

- Walk-in Service at Community Crisis Centre
  1st Floor Jeanne Mance Building
  1030 Ouellette Ave.
  Available 9:00 a.m. to 5:00 p.m. Monday - Friday

- Crisis Walk-in Service is available at Windsor Regional Hospital Ouellette Campus (1030 Ouellette Ave) Emergency Department from 7 - 11 p.m. 7 days a week

The Community Crisis Centre is a partnership of area hospitals and social organizations committed to providing 24-hour crisis response services to residents of Windsor and Essex County who are experiencing serious mental illness and/or acute psychosocial problems.

A variety of services are provided to reach individuals in crisis, including a 24-hour crisis phone line, follow-up crisis counseling and referrals. Crisis Walk-in Service is available at Windsor Regional Hospital Ouellette Campus (1030 Ouellette Ave) Emergency Department from 7 - 11 p.m. 7 days a week.

If you feel that counseling or therapy would be helpful for you, please contact any of the following resources on campus:

Student Counseling Centre

The SCC provides assessment, crisis intervention, and short term counseling and may provide a referral to the PSRC for longer-term therapy.

If it is your first visit to the SCC, to make an appointment you must go to the Student Counseling Centre office (Room 293 of the CAW Centre) in person. If you have been to the SCC in the past 6 months, you can call or email to make an appointment.

Contact Information:

Phone number: 519-253-3000 ext 4616
Monday - Friday - 8:30 am - 4:30 pm.

Closed 12:00 - 1:00 pm.

Student Counseling Centre
Room 293 CAW Centre
University of Windsor
401 Sunset Avenue
Windsor, Ontario
N9B 3P4
Canada

Psychological Services and Research Centre
Referrals are made through the Student Counseling Centre to the PSRC for longer-term therapy, if appropriate.

Contact:
Paulette Lafleur-Fleming, Office Coordinator
Phone: 519-253-3000 ext. 7012 or 519-973-7012
Email: luap@uwindsor.ca

The House on Riverside
Psychological Services and Research Centre (PSRC)
2629 Riverside Drive West
Windsor, ON
N9B 1B4

Peer support is also available on campus:

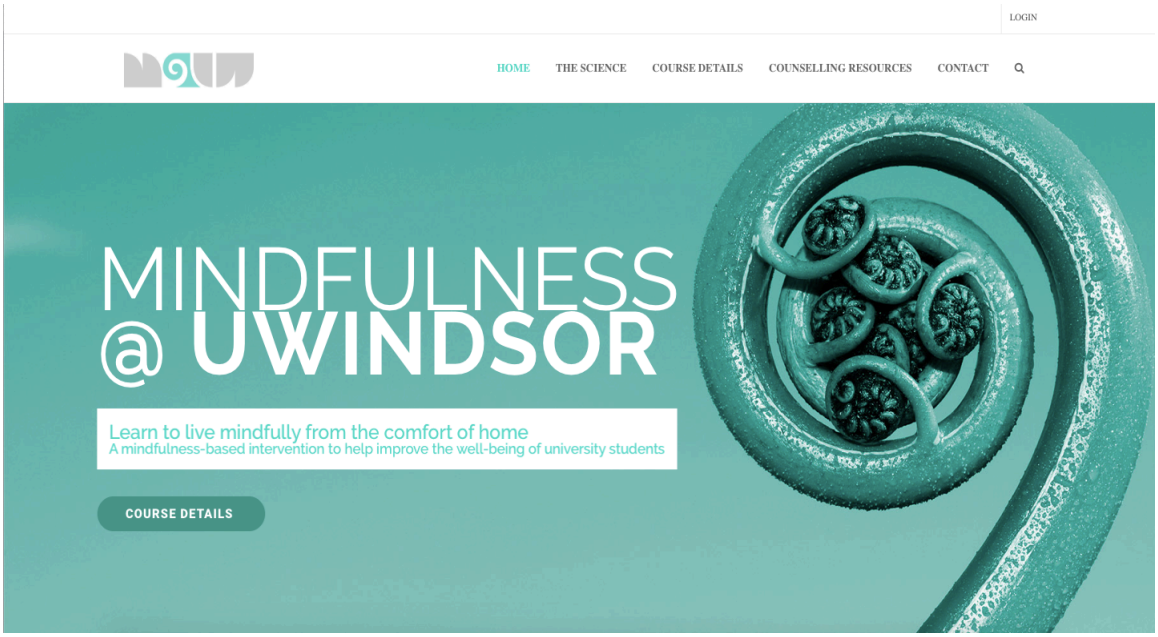
Peer Support Centre
The Peer Support Centre is a drop-in centre where students from across campus can find a supportive peer to talk to. It's a safe and inclusive space where trained peer support volunteers offer peer counselling to students.

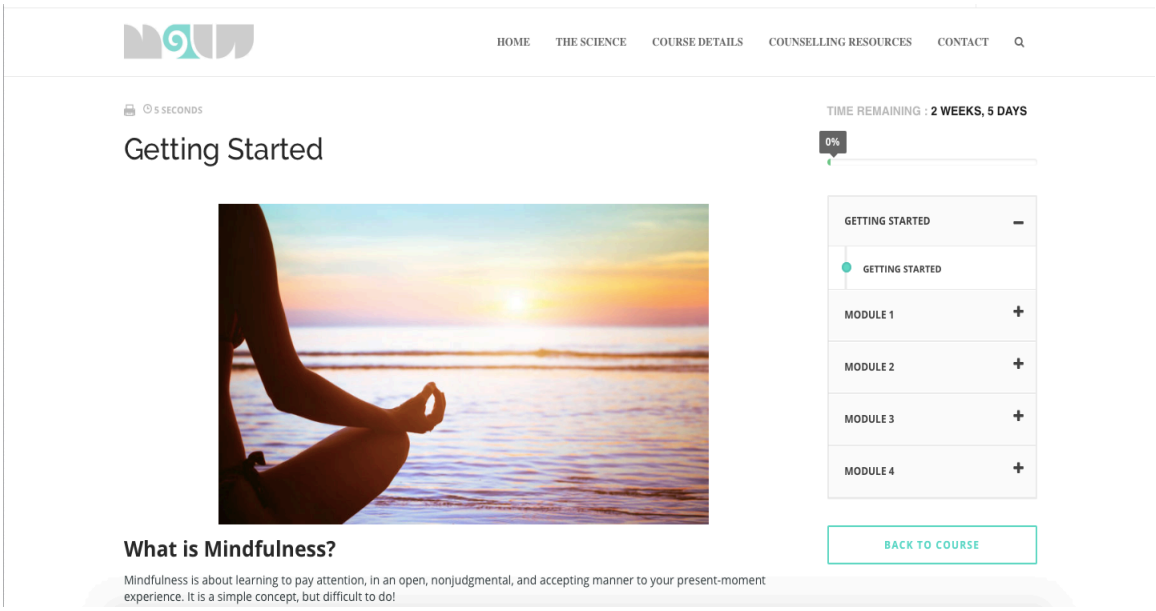
The volunteers are University of Windsor students who have gone through training to better enable them to give support to their peers. The Peer Support Centre is a UWSA initiative, in collaboration with the Student Counselling Centre. They are also supported by Student & International Affairs.

Contact:
John Antoniw
519-253-3000 Ext 4551
Peer Support Centre
CAW Student Centre
2nd Floor, Room 208
401 Sunset Ave, Windsor, ON, N9B 3P4
Monday-Friday: 10:00am – 6:00pm

Open every non-holiday weekday

Appendix F




HOME
THE SCIENCE
COURSE DETAILS
COUNSELLING RESOURCES
CONTACT
5 SECONDS
Getting Started
TIME REMAINING : 2 WEEKS, 5 DAYS
0%
GETTING STARTED
GETTING STARTED
MODULE 1
MODULE 2
MODULE 3
MODULE 4
BACK TO COURSE
What is Mindfulness?
Mindfulness is about learning to pay attention, in an open, nonjudgmental, and accepting manner to your present-moment experience. It is a simple concept, but difficult to do!

7 DAYS MINDFULNESS

MINDFUL BREATHING

TIME REMAINING : **2 WEEKS, 5 DAYS**

0%

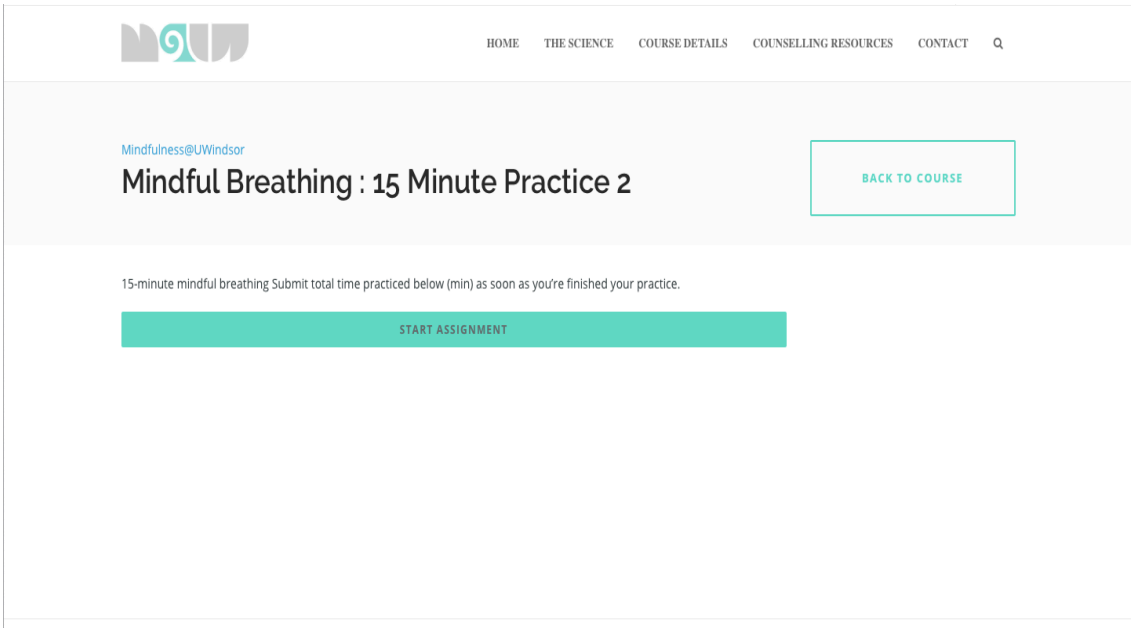
- GETTING STARTED +
- MODULE 1 −
  - MINDFUL BREATHING
- MODULE 2 +
- MODULE 3 +
- MODULE 4 +

BACK TO COURSE

Breathing meditation is a great stress-management skill. It teaches you to let thoughts come and go without letting them get in the way, refocus when you notice you're distracted, and accept your feelings without trying to change them.

Steps:

- Sit in a chair with your feet on the floor with your head lifted gently towards the ceiling.
- Place one hand on your chest and one hand on your belly.
- Close your eyes and breathe as you usually breathe.
- Notice your breathe. Does your chest or belly rises with inhalation? For some people when they breathe their belly expands allowing their lungs to inflate. For others, you might experience breathe in your chest, under your collar bones, or in your nose.
- The mind will wander – that's normal!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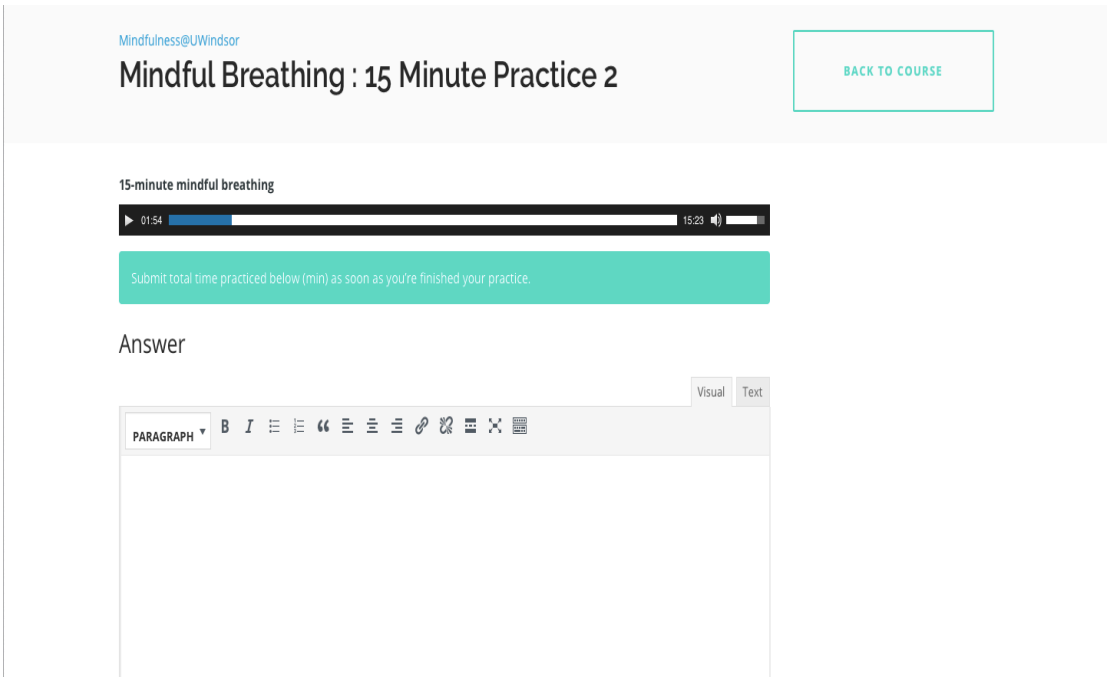
BACK TO COURSE
15-minute mindful breathing Submit total time practiced below (min) as soon as you're finished your practice.
START ASSIGNMENT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Mindful Breathing : 15 Minute Practice 2
BACK TO COURSE
15-minute mindful breathing
01:54
15:23
Submit total time practiced below (min) as soon as you're finished your practice.
Answer
Visual
Text
PARAGRAPH

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