Feasibility, acceptability, and outcomes of a brief mindfulness intervention for college students with posttraumatic stress symptoms and problem drinking

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Abstract

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The majority of college students will experience a traumatic event either before or during college, and a significant subset of those students experience PTSD symptoms. Additionally, many college students engage in problematic alcohol use. There is evidence that individuals with co-occurring PTSD symptoms and alcohol and other substance use disorders often use substances in an attempt to reduce their PTSD symptoms, and college students with PTSD symptoms experience more negative alcohol and drug consequences than those without PTSD. The relationship between PTSD and alcohol and other substance use disorders is often cyclical: individuals use substances to cope with PTSD symptoms, which in turn exacerbate symptoms and make them vulnerable to further traumatic experiences. Mindfulness interventions have been successfully utilized for individuals with PTSD or substance use disorders. However, to date, no previous studies have evaluated treatments for college students with co-occurring PTSD symptoms and problem drinking. This study evaluated the feasibility, acceptability, and efficacy

of a 4-week group loving-kindness meditation (LKM) compared to referral to treatment as usual (RTAU) for college students with PTSD symptoms and problem drinking. Seventy-six college students participated in the current study. Overall, the LKM group was feasible and acceptable to college students, although recruitment of eligible students into the study was lower than expected and attendance at LKM groups was modest. Participants' PTSD symptoms, drinking quantity, and negative drinking consequences decreased over the course of the study, although there was no significant differences between the LKM and RTAU conditions on these outcomes. Additionally, higher coping drinking motives predicted greater PTSD symptoms and more drinking consequences, highlighting the need for early effective intervention for individuals who drink to cope with their PTSD symptoms.

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Introduction

College represents a unique developmental period in young adults' lives. For many individuals, college will be the first time young adults live away from their parents and exclusively with a peer group. While students' college years are often a period of personal growth and increasing sense of autonomy, many students struggle with college's academic, social, and economic demands. The college years are also a time when many individuals are at risk for developing new mental health disorders or experiencing worsening of existing mental health conditions. Blanco and colleagues (2008) reported that 46% of college students experienced a psychiatric disorder in the past year. Thus, because college represents both an important developmental period and a period of increased risk, it may be an important intervention point in order to prevent mental health deterioration over individuals' lifespans.

This introduction will highlight the prevalence of trauma exposure and related mental health conditions, specifically posttraumatic stress symptomatology and alcohol and other substance use, in the college population. Additionally, the relationship between posttraumatic stress symptoms and alcohol use will be reviewed in the context of rationales and opportunities for treatment. In particular, evidence supporting a specific form of intervention – mindfulness-based treatments – for individuals with co-occurring posttraumatic stress symptoms and problematic alcohol use will be presented. Finally, a rationale for investigating mindfulness-based interventions in the college population will be put forth, from the perspective of efficacy, feasibility, acceptability, and economy.

Trauma Exposure and Posttraumatic Stress Among College Students

Trauma Exposure Among College Students. A high percentage of college students (66-84%) have experienced a traumatic event in their lifetime (Read, Ouimette, White, Colder, &

Farrow, 2011; Bernat, Ronfeldt, Calhoun, & Arias, 1998; Vrana & Lauterbach, 1994). The types of traumas that students experience varies: in one study of college freshman, 34% reported experiencing a sudden, unexpected death of a friend or family member; 27% reported experiencing an accident, natural disaster, or fire; 24% reported experiencing physical violence; and 7% reported experiencing unwanted sex (Read et al., 2011).

Additionally, a significant subset of students experience traumatic events *during* college. Most research on trauma during college focuses on sexual victimization, or unwanted sexual harassment or contact. The rates of these traumatic exposures are high: in one sample, 19% of women reported experiencing a completed or attempted sexual victimization since entering college (Krebs, Lindquist, Warner, Fisher, & Martin, 2009). Additionally, a nationally representative sample of 4,446 women found a victimization rate of 27.7% attempted or completed rapes per 1,000 female students (Fisher, Cullen, & Turner, 2000), a rate nearly fourteen times greater than the victimization rate of 2.1 per 1,000 women found in a community sample (Planty, Langton, Krebs, Berzofsky, & Smiley-McDonald, 2013). Given that female college students are at a greater risk of experiencing certain types of trauma exposure (i.e., sexual victimization) than the general population, college can be conceptualized as a high-risk period for exposure to certain types of traumatic events. Other trauma exposure (e.g., motor vehicle accidents) can occur in the context of high-risk drinking, which is common among college students (as described below). In sum, college is an environment in which students are exposed to a variety of situations that may result in trauma exposure.

Rates of PTSD in college students. Reactions to traumatic experiences sometimes persist, and 9-12% of college students meet criteria for posttraumatic stress disorder (PTSD) (Read et al., 2011; Bernat et al., 1998). This rate is higher than the six-month prevalence rate of

PTSD found in adolescents ages 12 to 17 (3.7-6.3%; Kilpatrick et al., 2003) and the 12-month prevalence rate of PTSD in adults ages 18-64 (4.4%; Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). Importantly, the differences in prevalence rates between college students and a younger adolescent and general adult population may be due to differences in how PTSD was assessed. Self-report measures of PTSD, which have been used in several studies of college students, as opposed to clinician-administered PTSD assessments, can overdiagnose PTSD (Griffin, Uhlmansiek, Resick, & Mechanic, 2004). However, even with the limitations regarding PTSD assessment via self-report screens, college students still experience rates of PTSD at least in line with the general population (Kilpatrick et al., 2013). This finding demonstrates that while college students are often thought to be a "high functioning" subset of the population, they are still as vulnerable to PTSD as the general population. The widely held conception of the college population as a privileged subset stems from an earlier era when attendance at college was the exception rather than the rule. However, today, the majority of high school students (69.2%) enroll in college (US Bureau of Labor Statistics, 2016); as a result, today's college population is increasingly representative of the population as a whole.

PTSD sequelae. While some individuals' PTSD symptoms will remit over time naturally, many will continue to experience symptoms for years after the traumatic event (Orcutt, Erickson, & Wolfe, 2004; Yule et al., 2000). In addition to the distress caused by PTSD symptoms themselves, PTSD is associated with negative health consequences including hypertension (Kibler, Joshi, & Ma, 2009), heart disease (Kubzansky, Koenen, Spiro, Vokonas, & Sparrow, 2007), and substance use disorders (Brady, Back, & Coffey, 2004). PTSD has also been associated with suicide risk in nationally representative samples (Cougle, Keough, Riccardi, & Sachs-Ericsson, 2009; Nepon, Belik, Bolton, & Sareen, 2010; Sareen, Houlahan, Cox, &

Asmundson, 2005). Thus, in addition to preventing prolonged distress, early effective intervention for PTSD is potentially important from a public health perspective.

Subthreshold PTSD. Research with non-college student populations suggests that individuals may experience posttraumatic stress symptoms without meeting full diagnostic criteria for the disorder despite experiencing distress related to their exposure to traumatic events (Cukor, Wyka, Jayasinghe, & Difede, 2010; Zlotnick, Franklin, & Zimmerman, 2002; Bergman, Kline, Feeny, & Zoellner, 2015). There is evidence that college students with PTSD symptoms experience problems that can also affect their functioning. For example, college students with PTSD symptoms experience more drinking consequences than those without PTSD symptoms (summarized below). Additionally, college students with higher PTSD symptoms are more likely to drop out of college than those who stayed in college for four years (Duncan, 2000). Importantly, subthreshold PTSD symptoms can be reduced through mental health treatment (Dickstein, Walter, Schumm, & Chard, 2013), suggesting that college students with PTSD symptoms, in addition to students who meet full diagnostic criteria, are an appropriate target for intervention, given subthreshold PTSD symptoms' impact on students' overall wellbeing and success in college.

Alcohol Use in College Students

As well as experiencing high rates of trauma exposure, college students are at risk for problematic alcohol use. Almost half (40-44%) of college students report heavy episodic or "binge" drinking (four or more drinks in one sitting for females, five or more for males) at least biweekly (O'Malley & Johnston, 2002; Wechsler et al., 2002), and alcohol use disorders are the most common psychiatric disorder among college students (Blanco et al., 2008). Problematic alcohol use often results in some form of negative consequences (e.g., academic problems,

sexual victimization, legal consequences; Perkins, 2002), and students may continue to engage in problem drinking after they graduate.

College students' drinking has serious public health implications. In the United States in 2001, there were 1,717 unintentional alcohol-related injury deaths, nearly 600,000 alcohol-related injuries, and 696,000 assaults committed by college students who had been drinking (Hingson, Heeren, Winter, & Wechsler, 2005). The effects of college students' drinking may not be limited to individuals on campuses: 31.4% of college students report driving under the influence, posing a serious risk to the broader community population (Hingson et al., 2005). Importantly, compared to their non-college-attending peers, college students are significantly less likely to have received past-year treatment for alcohol or drug use disorders (Blanco et al., 2008). The high rates of alcohol abuse, coupled with the low frequency of treatment seeking in this at-risk population, underscores the need for effective, feasible, and acceptable interventions to address high-risk drinking.

Motivations for Alcohol Use. One important consideration in developing interventions for college student drinking is students' motivations for drinking. The literature presents a complex and varied picture of college student motivation for drinking. Student alcohol use and alcohol problems are most closely related to social reinforcement (e.g., to facilitate social interaction) and enhancement (e.g., to induce positive affect) motives (Read, Wood, Kahler, Maddock, & Palfai, 2003). Additionally, students may drink because they perceive peers as drinking heavily or believe high levels of drinking are acceptable (Larimer, Turner, Mallett, & Geisner, 2004). There is also evidence that adolescents may drink to seek out exciting experiences, without thinking of longer-term consequences (Stautz & Cooper, 2013). However, other literature suggests college students also drink for negative reinforcement motives (e.g., to

relieve tension) (Carey & Correia, 1997), to regulate negative affect (Kassel, Jackson, & Unrod, 2000), and to cope with external stressors (Park & Levenson, 2002). Put simply, some college students drink as a means to avoid, or cope with, negative thoughts and emotions. Importantly, drinking in an effort to cope with negative thoughts or external stressors is more strongly associated with alcohol-related problems than drinking initiated for other reasons (Kuntsche, Knibbe, Gmel, & Engels, 2005), suggesting that individuals who drink to cope may be in greater need of intervention than those who drink for other reasons.

Posttraumatic Stress Symptoms and Problem Drinking in College Students

Epidemiological studies have found a high rate of co-occurrence between PTSD and alcohol use disorders (AUD) and other substance use disorders (SUD) (Grant et al., 2015; Grant et al., 2016). Adults with PTSD are two to four times more likely to have a SUD than those without PTSD (Kessler, Chiu, Demler, Walters, 2005). There is a strong link between PTSD and co-occurring alcohol use in non-college populations, including female sexual assault victims and veterans (Kaysen et al., 2013; Seal et al., 2011; Ullman, Relyea, Peter-Hagene, & Vasquez, 2013). Among college students who reported heavy episodic drinking in the past month, 16.9% had elevated PTSD symptoms (Monahan et al., 2013). Although college students engage in problem drinking for a number of different reasons (Read et al., 2003), there is evidence that college students experiencing PTSD symptoms often drink heavily to cope with these symptoms (Miranda, Meyerson, Long, Marx, & Simpson, 2002). In one study of college students, symptoms of posttraumatic stress, specifically dissociation and intrusive thinking, predicted self-reported increased use of alcohol (Edwards, Dunham, Ries, & Barnett, 2006).

Furthermore, there is also evidence that college students with PTSD have worse drinking outcomes than those who do not have PTSD. In one study, newly matriculated college students

with partial and full PTSD began their first year of college with more alcohol and drug consequences than those without PTSD. Although they experienced a greater decrease in consequences over the first semester of college than peers without PTSD, their alcohol and drug consequences still remained higher than those without PTSD (Read et al., 2012). Another study of college women had similar findings, such that those with trauma exposure and PTSD consumed more alcohol and were at greater risk of experiencing alcohol-related consequences compared to women with no trauma history (Stappenbeck, Bedard-Gilligan, Lee, & Kaysen, 2013).

In addition to experiencing greater alcohol-related consequences, students with PTSD symptoms who drink may also be at increased risk for future trauma exposure. In a prospective study, PTSD predicted alcohol use and rape that occurred during the study, and alcohol use mediated the relationship between PTSD symptomatology and rape during the follow-up period (Messman-Moore, Ward, & Brown, 2009). As such, a vicious cycle of drinking to cope can lead to future risk for trauma exposure, which in turn, can then lead to increased problematic drinking to cope (Borsari, Read, & Campbell, 2008). Thus, for young adults with PTSD and problem drinking, college may be a critical time for intervention, since effective early intervention could "break the cycle," decrease chronicity, and lessen the need for PTSD and alcohol treatments in the future.

Theories for high PTSD and AUD co-occurrence

At least four major hypotheses have been proposed to explain the high rate of co-occurrence of PTSD and AUD and other SUDs (McCauley, Killeen, Gros, Brady, & Back, 2012). These hypotheses are referred to as the *high-risk hypothesis*, the *susceptibility hypothesis*, the *shared vulnerability hypothesis*, and the *self-medication hypothesis*.

The *high-risk hypothesis* posits that pre-trauma substance use increases risk for trauma exposure and subsequent PTSD, because individuals who use substances are often in high-risk situations and may have an impaired ability to detect danger cues in the environment (Davis, Stoner, Norris, George, & Masters, 2009). The *susceptibility hypothesis* proposes that individuals with chronic substance use experience increased anxiety and arousal as a result of their substance abuse, which in turn increases biologic vulnerability to developing PTSD subsequent to trauma exposure (Chilcoat & Breslau, 1998)[1]. The *shared vulnerability hypothesis* suggests that individuals possess latent risk factors, both environmental and genetic, that predispose them to develop both PTSD and SUD (Stewart & Conrod, 2008). For example, the PTSD-SUD comorbidity may be influenced by latent factors of personality, such as internalizing–externalizing dimensions (Kramer, Polusny, Arbisi, & Krueger, 2014). The hypothesis with the most research support is the *self-medication hypothesis*, which posits that PTSD symptoms and substance use are functionally related via a negative reinforcement model, specifically that individuals use substances to alleviate their PTSD symptoms (e.g., Reed, Anthony, & Breslau, 2007).

There is accumulating evidence supporting the self-medication hypothesis. For example, one longitudinal study examined these four hypotheses in an adolescent community sample. The self-medication hypothesis received the strongest support in that PTSD symptoms predicted high levels of subsequent alcohol and drug problems, over and above the influences of pre-trauma family risk factors, pre-trauma substance use problems, trauma exposure, and demographic variables (Haller & Chassin, 2014). Another study examined PTSD and SUD symptoms of

[1] A related hypothesis is *recovery interference*, which suggests that an individual's substance use interferes with the natural recovery process after a traumatic event, increasingly the likelihood of PTSD symptomatology (Kaysen et al., 2006).

individuals in outpatient SUD treatment and found that weekly PTSD symptom fluctuations were concurrently associated with alcohol and cocaine dependence symptoms and opiate dependence symptoms the following week, supporting the idea that individuals used substances to cope with PTSD symptoms (Ouimette, Read, Wade, & Tirone, 2009). A third study examined daily associations between PTSD and alcohol use in a community sample of individuals with PTSD and alcohol dependence (Simpson, Stappenbeck, Luterek, Levahot, & Kaysen, 2014). Elevated PTSD symptoms predicted greater alcohol use on the same day and on the following day. Additionally, coping drinking motives moderated the relationship between PTSD symptoms and alcohol consumption, such that for individuals with higher coping drinking motives, a one-unit increase in PTSD symptoms was associated with a 37% increase in alcohol consumed, compared to a 10% increase in consumption for those low on coping drinking motives.

Taken together, these studies provide support for the self-medication hypothesis as an explanation for why PTSD and SUD commonly co-occur. Understanding the functional relationship between PTSD symptoms and alcohol and drug use, such as using substances to reduce PTSD symptoms, is a critical step in developing a treatment for reducing co-occurring PTSD and substance use, as it points to potential intervention targets to address the underlying causes that perpetuate symptomatology and substance use.

Treatment for Posttraumatic Stress Symptoms and Alcohol Use

As research has highlighted the high rate of co-occurrence between PTSD and alcohol and other substance use and elucidated their interrelationship, interventions have been developed to treat individuals with this constellation of disorders. A recent review synthesized findings from randomized clinical trials evaluating behavioral treatments for individuals with PTSD and co-occurring alcohol and drug problems (Simpson, Levahot, & Petrakis, 2017). The authors

identified 24 studies that examined three types of interventions for co-occurring PTSD and substance use: exposure-based interventions (seven studies), addiction-focused interventions (six studies), and coping-based interventions, which do not include an in-depth trauma discussion (11 studies). While most of the exposure-based treatment resulted in greater reductions in PTSD symptoms compared to control conditions, none of the studies found favorable outcomes for the experimental treatment for both PTSD and substance use (Simpson et al., 2017). Additionally, to date, treatments for PTSD and substance use have been studied using clinical samples (i.e., patients who meet diagnostic criteria for PTSD), and treatment has been provided in an individual therapy modality. Less is known about the effectiveness of interventions among non-clinical populations with subthreshold PTSD symptoms and problematic substance use, and treatment provided in groups and in other lower-cost non-medical settings.

One potential intervention for co-occurring PTSD (or subthreshold PTSD symptoms) and problematic alcohol use is mindfulness-based treatment. Mindfulness has been described as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (Kabat-Zinn, 1994). It is a multi-focused practice, with both an attentional object (the present moment) and specific attitude (e.g., a non-judgmental, compassionate stance) (Shapiro, Carlson, Astin, & Freedman, 2006). Mindfulness-based interventions have been developed and utilized for individuals with a wide range of physical and psychological disorders, including chronic pain (Kabat-Zinn, 1982; Morone, Greco, & Weiner, 2008), anxiety (Vøllestad, Nielsen, & Nielsen, 2012), and depression relapse (Piet & Hougaard, 2011). Mindfulness-based interventions have also begun being used for individuals with PTSD or SUDs, and initial research on their effectiveness for individuals with PTSD or substance use disorders has been promising.

Mindfulness treatment of PTSD. A recent systematic review and meta-analysis examined the effects of mindfulness-based interventions for PTSD within a randomized controlled trial study design (Hilton et al., 2016). In a pooled analysis of eight interventions that reported on PTSD symptoms pre- and post-treatment, a small effect of mindfulness interventions on PTSD symptoms was found. Additionally, mindfulness-based interventions resulted in significantly greater reductions in PTSD symptoms than comparator treatment conditions. However, there was heterogeneity between study results, and study quality was mixed, suggesting the quality of evidence is low at this stage. Additionally, the *type* of mindfulness-based intervention varied considerably (three yoga interventions, three Mindfulness Based Stress Reduction programs, and two mantra repetition programs), making it difficult to gauge the efficacy of mindfulness-interventions for PTSD as an overarching intervention type.

Mindfulness treatment of substance use. Another recent systematic review and meta-analysis examined the efficacy of mindfulness-based interventions for individuals with substance misuse (Li, Howard, Garland, McGovern, & Lazar, 2017). Forty-two studies (34 RCTs and eight quasi-experimental studies) were included in the meta-analysis. In all but one study, mindfulness treatments were superior to the comparator treatment condition with respect to pre-to post-treatment reductions in quantity and frequency of alcohol and drug use, number of alcohol and drug-related problems, and level of craving for substance use. In the subset of studies from which effect sizes could be calculated, the overall synthesized effect size indicated that, compared to comparator treatment conditions, mindfulness interventions had a significant small effect in reducing substance use.

While the aforementioned reviews suggest effectiveness of mindfulness interventions in adult populations with PTSD or substance use disorders, no studies to date have evaluated

mindfulness for both posttraumatic stress symptoms and problem drinking within a college population. Additionally, the heterogeneity of the mindfulness interventions included in the reviews makes it difficult to determine the relative efficacy of different types of mindfulness interventions.

One type of mindfulness practice, Loving-Kindness Meditation (LKM), has shown promise as a treatment for PTSD and may help reduce drinking to cope. LKM is derived from Buddhist traditions and involves increasing positive emotions and kindness towards oneself and others (Hofmann, Grossman, & Hinton, 2011). In LKM, individuals silently repeat phrases of positive intention for themselves, other people to whom they feel close in their lives, a neutral person, a difficult person in their life, and people who are unknown to them. LKM addresses avoidance in that it is an approach-oriented practice. Participants repeatedly bring to mind individuals about whom they have ambivalent feelings (potentially including themselves), which allows for exposure to thoughts and emotions they might otherwise attempt to avoid. Additionally, discussion of LKM practices help people attend to areas in which they feel stuck or resistant, which counters avoidance of negative feelings towards self and others, and emphasizes tolerating, accepting, and approaching negative feelings and thoughts despite a sense of vulnerability or ambivalence. In one open-trial study of a 12-session group LKM intervention for male and female veterans with PTSD, a large effect size was reported for reduction in PTSD symptoms at the end of treatment and 3 months post LKM. Additionally, participants found the treatment acceptable (Kearney et al., 2013). Importantly, acceptance of thoughts, emotions, and physical responses has been found to be related to reduced drinking in a mindfulness treatment for substance abuse (Bowen at el., 2009). Thus, there is preliminary empirical support for why mindfulness interventions such as LKM may be effective for college students with both

posttraumatic stress symptoms and problem alcohol use. The section below provides a theoretical framework delineating the mechanisms through which mindfulness may reduce PTSD symptoms and problem drinking.

Mechanisms Through Which Mindfulness May Target PTSD and Drinking

Cognitions in PTSD. One hallmark of PTSD is negative beliefs about oneself and others. Individuals often experience doubts about others' trustworthiness, the safety of the world, and one's own worth. In particular, negative thoughts about self (e.g., blaming oneself for the traumatic event) are associated with increased PTSD severity (Moser, Hajcak, Simons, & Foa, 2007). Shifting negative beliefs or increasing more positive, incompatible beliefs about oneself and others is therefore important in addressing PTSD symptoms. Mindfulness treatments, such as LKM, which emphasize cultivating positive emotions and thoughts about oneself and others, can help shift pervasive negative beliefs about oneself (e.g., I'm a weak person) and others (e.g., people are not what they seem) that are often associated with PTSD and can lead to coping behaviors such as drinking.

Avoidance in PTSD. Another important mechanism in the maintenance of PTSD symptoms is avoidance behavior (Pineles et al., 2011). Avoidance can be expressed as overt behaviors, such as avoiding places or people that remind individuals of the traumatic event. It can also be expressed through private, internal processes such as experiential avoidance, including the deliberate blocking of traumatic experiences, traumatic memories, and negative emotions (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). Evidenced-based PTSD therapies identify increasing emotional engagement with trauma narratives as a key step in treating PTSD (Hembree & Foa, 2000). Thus, experiential avoidance remains an important intervention point for addressing PTSD symptomatology. Mindfulness interventions, including LKM, explicitly

emphasize attending to thoughts, emotions, and bodily sensations that the person is currently experiencing, and thus, directly counteract avoidant behavior (Roemer, Williston, Eustis, & Orsillo, 2013).

Self-compassion and PTSD. Self-compassion, defined as an awareness of one's own suffering and having the desire to alleviate that suffering (Neff 2003a), is negatively related to psychopathology, such that higher levels of self-compassion are associated with lower levels of symptomology (MacBeth & Gumley, 2012). Self-compassion is negatively associated with the PTSD avoidance/numbing cluster (Thompson & Waltz, 2008), suggesting that higher levels of self-compassion may be related to not avoiding traumatic memories, thoughts, emotions, or external reminders of traumatic events. There is preliminary support for self-compassion as a mechanism through which mindfulness interventions may reduce PTSD symptoms. In Kearney and colleagues (2013) 12-week LKM intervention study, PTSD symptoms significantly decreased at post-treatment and three months later, and a large effect size was reported for these reductions in PTSD symptoms at both time points. At baseline, PTSD symptoms were negatively correlated with self-compassion scores, and changes in self-compassion significantly mediated changes in PTSD symptoms between baseline and post-treatment and between baseline and 3 months post-treatment.

In summary, mindfulness techniques, which emphasize attending to present moment experiences with nonjudgmentalness and openness, target experiential avoidance, a key facet of both PTSD and coping-related problem alcohol use. Mindfulness interventions can be conceptualized as a form of exposure to negative emotions and cognitions that may lead to avoidant behavior (both overt and internal) and maladaptive coping behavior such as problem drinking. Additionally, mindfulness interventions such as LKM can increase self-compassion,

which may reduce negative emotions associated with PTSD and reduce drinking to alleviate these negative emotions. Because mindfulness targets negative cognitions and avoidance – cross-cutting, transdiagnostic maladaptive behaviors – it supports recent efforts to find intervention points not limited to single diagnoses (Insel et al., 2010), and, thus, may be particularly well-suited to addressing co-occurring mental health issues.

Need for Scalable, Stepped Care Interventions

LKM, and mindfulness interventions more generally, can be delivered in a group format and led by non-specialist mental health providers, addressing the need to create more scalable, wide-reaching, and cost-effective psychological interventions (Kazdin & Rabbitt, 2013), a goal in line with the National Institute of Health's agenda to reduce the burden of mental illness among Americans. College campuses also provide an ideal alternative to mental health treatment centers, as students are already gathered in one area and may be more likely to attend treatment near their living space. Additionally, offering mental health programming on college campuses potentially reduces students' concerns about the stigma of seeking treatment at a mental health clinic, further reducing barriers to receiving care.

Mindfulness interventions such as LKM delivered on college campuses can be considered the "first step" of a stepped care approach to mental health treatment, which aims to provide the lowest level of intervention, in terms of both patient and provider resources (Bower & Gilbody, 2005). Individuals who do not improve at lower levels of care "step up" to different and more comprehensive treatments, which generally consume a higher level of resources. In any stepped care system, lower level treatment must lead to clinical improvement for a proportion of patients and be considered acceptable to the majority of patients and providers (Bower, & Gilbody, 2005). Stepped care approaches have been utilized in clinical samples of

individuals with physical injuries in trauma surgical settings with elevated PTSD symptoms (Zatzick et al., 2013) and in problem drinkers (Breslin et al., 1998; Reinhardt et al., 2008). LKM groups may be an effective and sufficient lower level intervention for students with PTSD symptoms and problem drinking, lessening the overall demand for higher level, higher cost individual treatment by specialized mental health providers.

Feasibility and Acceptability

When evaluating a novel intervention, feasibility and acceptability remain important considerations, separate from considerations of efficacy. Broadly, feasibility studies seek to "determine whether an intervention is appropriate for further testing; in other words, they enable researchers to assess whether or not the ideas and findings can be shaped to be relevant and sustainable" (p. 453, Bowen et al. 2009). *Feasibility* is the extent to which a new intervention can be successfully used or carried out within a given setting (Proctor et al., 2011). *Acceptability* refers to how intended individual recipients react to the intervention (Bowen et al. 2009). An intervention may be adaptable to a particular setting (feasible), but fail because it is not acceptable to clients found in that setting. Put simply, an intervention that has demonstrated efficacy in a clinical research environment may have limited utility if it cannot be successfully delivered in a real-world setting or if the individuals for whom the intervention is intended are not satisfied with the program or will not partake in it. Evaluating the feasibility and acceptability of an intervention for college students with PTSD symptoms and problem drinking is therefore of considerable importance, as no interventions have been systematically evaluated in this unique population.

Summary

The majority of college students will experience a traumatic event either before or during

college, and a substantial minority of those students experience PTSD symptoms (Read et al., 2011). Additionally, many college students engage in problematic alcohol use (Blanco et al., 2008; Wechsler et al., 2002). There is evidence that individuals with co-occurring PTSD symptoms and alcohol and other substance use disorders often use substances in an attempt to reduce their PTSD symptoms (Simpson et al., 2014), and college students with PTSD symptoms experience more negative alcohol and drug consequences than those without PTSD (Read et al., 2012). Brief, accessible interventions may be helpful in addressing the unique circumstances of college students with both PTSD symptoms and problem drinking.

Mindfulness interventions have been successfully utilized for individuals with PTSD and individuals with alcohol misuse and other SUDs in non-college settings. Additionally, mindfulness interventions may target several of the factors maintaining PTSD symptoms, and by extension, maintaining drinking behaviors used to cope with PTSD symptoms, including negative cognitions, experiential avoidance, and low self-compassion. Mindfulness interventions additionally have the benefit of being deliverable in a group format, and may therefore serve as a first, less intensive step in a comprehensive treatment program, that provides more intensive mental health services for individuals who do not benefit from lower levels of care.

However, to date, no studies have evaluated treatments for college students with co-occurring PTSD symptoms and problem drinking. The next section will describe a study designed to address this gap in the research literature, by evaluating the feasibility, acceptability and efficacy of a brief mindfulness intervention for college students with PTSD symptoms and problem drinking.

Current Study

The current study evaluates the feasibility, acceptability, and outcomes of a time-limited,

group mindfulness intervention based on LKM for college students with PTSD symptoms and problem drinking compared to referral to treatment as usual (RTAU). The two primary study hypotheses were:

1) Implementing LKM would be feasible and college students would find the intervention acceptable.
2) Participants who received LKM would experience significantly greater reductions in PTSD symptoms as well as greater reductions in drinking quantity and negative drinking consequences at post-treatment and 1-month follow-up, compared to RTAU.

A third hypothesis was also examined: The effect of LKM on reducing PTSD symptoms, problem drinking, and negative drinking consequences from baseline to follow-up would be mediated by decreases in experiential avoidance and posttraumatic negative cognitions and increases in self-compassion from baseline to post-treatment. However, this hypothesis was considered exploratory, given that the study was not powered to detect meditational effects.

Methods

Participants

Inclusion criteria. Participants ($N = 75$) were young adult college students (ages 18 to 29) at the University of Washington who endorsed heavy episodic drinking, defined as drinking four or more (for women) or five or more (for men) drinks on one occasion at least twice in the past month (Wechsler & Nelson, 2001). In the initial study design, participants also had to meet hazardous drinking criteria as defined by the Alcohol Use Disorders Identification Test (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). However, when the study was piloted during the Fall 2015 quarter, this inclusion criteria was deemed overly restrictive (e.g., less than 30 students met the AUDIT hazardous drinking criteria) and removed in subsequent quarters.

Participants also had to report experiencing a traumatic event that qualified as a Criterion A event for PTSD, defined by the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013), based on their endorsement of at least one of 16 types of events on the Life Events Checklist (LEC-5; Weathers et al., 2013). Additionally, participants had to endorse experiencing PTSD symptoms in at least two of the four PTSD symptoms clusters (intrusive symptoms, avoidance, negative alterations in cognition and mood, and alterations in arousal and reactivity), to ensure that they were experiencing at least some variability and complexity in their symptoms, even if below PTSD diagnostic threshold. Participants' PTSD symptoms also had to have lasted for more than one month, to ensure that their symptomatology was not an acute post-trauma symptom response. Including students who are experiencing PTSD symptoms without meeting full criteria for PTSD is common in studies with non-clinical samples of college students (Read et al., 2011; Thompson & Waltz, 2010; Edwards et al., 2006), and there is evidence that groups with subthreshold PTSD

that can still benefit from trauma-focused treatment (e.g., Dickstein et al., 2013).

Exclusion criteria. Students were excluded from the study if they reported active suicidality or psychotic symptoms, since the study was not resourced to provide ongoing individual risk assessment and management during the study. At the in-person screening, students completed the P4 survey (Dube, Kurt, Bair, Theobald, & Williams, 2010), a 4-item suicide screening tool, which asks about suicide ideation, past suicide attempts, plans, probability of completing suicide, and preventive factors. The P4 classifies individuals as falling into three risk categories: minimal, low, and high. Students were excluded from the study if they fell into the high-risk category (e.g., intention to act on thoughts of hurting oneself and/or an absence of anything that would prevent or keep them from harming oneself). In addition, individuals were excluded if they indicated experiencing two out of three items in the psychosis subscale of the Revised Behavior and Symptom Identification Scale (BASIS-24; Eisen, Normand, Belanger, Spiro, & Esch, 2004). Specifically, a student was excluded from the study for responding "often" or "very often" in the past week to any two of the following three items: how often… "did you think you had special powers?", "hear voices or see things?" or "think people were watching you?"

Study Design

This study used a randomized control design. Participants were randomly assigned to one of two conditions: a 4-week Loving-Kindness Meditation (LKM) group or referral to treatment as usual (RTAU). Participants were assessed at baseline, immediately post-treatment or referral 4-weeks later, and at a one-month following treatment or referral on measures of PTSD symptoms, drinking quantity, and negative drinking consequences. Additionally, participants completed three brief weekly measures to assess current drinking and PTSD symptomatology

and to examine rate and pattern of change over the course of the study. Participants also completed weekly measures of experiential avoidance, negative cognitions, and self-compassion to examine the hypothesized mechanisms of change in LKM. The Institutional Review Board at the University of Washington approved all study procedures. Additionally, because of the sensitive nature of some of the data collected (e.g., information on underage drinking), a certificate of confidentiality was issued by the National Institute on Alcohol Abuse and Alcoholism for additional protection of research participants.

Procedures

Recruitment. Participants were recruited from the University of Washington Psychology Subject Pool (PSP). The PSP is comprised of students enrolled in large Psychology classes at the University of Washington, primarily from Psychology 101 classes. PSP participants were able to complete screening surveys for the study as part of the online Psychology Screening Survey (PSS). The PSS was available to all students in the PSP for the two weeks near the beginning of the quarter. If students met the study inclusion criteria contained in the screening surveys, they were contacted by email and phone and invited to participate in an additional assessment for the study. Specifically, research assistants sent three emails and made three phone calls in an effort to reach potential participants. If students indicated they were interested in additional screening for the study, an in-person meeting was scheduled. In this meeting, two additional screening measures assessing exclusion criteria (active suicidality and/ or current psychotic symptoms) were administered. If students did not meet exclusion criteria, they were invited into the study, provided informed consent, and asked to complete baseline measures. After completing the baseline measures, participants were randomized to study condition (either LKM or RTAU) and informed of their randomization condition via email.

Randomization. Stratified random sampling using a minimization protocol (Scott, McPherson, Ramsay, & Campbell, 2002) was used to ensure groups were equivalent on gender and level of PTSD symptomology based on their PSS responses. Participants were randomized using a 1:1 ratio, such that equal numbers of participants were assigned to the LKM and RTAU conditions.

Participant compensation. Participants received up to six hours of class extra credit for participation in the study. Students who chose not to participate in the study after attending the in-person screening, reading the informed consent document, and asking questions were still given extra credit for their attendance at the in-person screening meeting in order to avoid risk of coercion (0.5 credit hours). Additionally, participants received a $15 electronic Amazon gift card for completing the one-month follow-up assessment.

Assessment. After providing informed consent, participants in both conditions completed a paper-and-pencil baseline assessment. During the course of the study, participants in both conditions completed three brief weekly measures online to assess current drinking, PTSD symptomatology, negative cognitions, experiential avoidance, and self-compassion. Participants were also asked if they attended any other treatment during the week, and, if so, the type of treatment they received. At the end of the four weeks, participants in both conditions completed post-treatment assessments online, which were the same as the baseline assessments with an additional measure of intervention feasibility and acceptability for the LKM group. One month later, all participants were asked to complete follow-up measures online. Participants were sent weekly reminder emails asking them to complete the online assessments if they had not yet done so. All online assessments were administered using the software survey tool DatStat. Data were collected for the study over four academic quarters, between September 2015 and January 2017.

Mindfulness intervention. The material for the LKM group was drawn from Kearney and colleagues' LKM manual utilized in their open trial, which was found to be efficacious in an open-trial with male and female veterans with PTSD (Kearney et al., 2013). This study utilized a 4-week group LKM format, a shortened version of the 12-week intervention use by Kearney and colleagues. The 4-week intervention maintained all core elements of the full LKM intervention, but condensed the three-session introduction to LKM into one session and shortened some of the exercises, which allowed for multiple exercises to be practiced in each group. The intervention was condensed to allow it to be delivered in one academic quarter, with the goal of developing a time-limited intervention that fit into a collegiate environment and would be well accepted by students. The LKM group included three components: brief didactic teaching of mindfulness principles and exercises, including a rationale for how the mindfulness exercises may be beneficial to participants; an experiential component where participants practiced the mindfulness exercises taught; and a time for group reflection on the exercises and wrap up. Participants were also asked to practice the week's specific LKM exercises for 15 minutes per day and were given an audio recording with a guided meditation to use. The LKM groups included between two and 10 participants. LKM groups were held in the late afternoon (between 4pm and 6pm) on weeknights in the University of Washington psychology buildings. Participants randomized to the LKM condition were emailed and called weekly to remind them to attend the group and, if participants missed the group, they were sent an email with the LKM homework exercises and inquiring about their absence. Each LKM group met weekly for one hour for four weeks and was facilitated by two graduate student leaders with masters in clinical psychology. Three graduate students served as group leaders over the course of the study. Each graduate student had attended at least one mindfulness meditation retreat and had an independent

mindfulness practice. The LKM group was audio recorded and a supervisor, Dr. Sarah Bowen, an expert in mindfulness intervention design and delivery, reviewed the four sessions, to ensure the LKM intervention was being delivered as intended. The graduate students met for supervision with Dr. Bowen weekly for feedback on the LKM group.

Referral to Treatment as Usual. The RTAU group did not meet in person during the four weeks of the study. At baseline, participants in both conditions were provided with a referral list including the number for the King County crisis hotline and several low cost or free mental health and substance abuse counseling services on both the University of Washington campus and in the Seattle community, to help ensure participants had access to the standard of care treatments for heavy episodic drinking and PTSD symptoms. After randomization, participants in both conditions were encouraged to review the referral list and access relevant services.

Measures

Table 1 presents the time points in the study when each measure was administered to participants. The measures were as follows:

Demographic. Age, sex, race, sexual orientation, residence, and year in school were assessed through the PSS screening survey.

Careless responder question. Careless or inattentive responding is a concern when administering self-report surveys (Meade & Craig, 2012). Because participants were recruited from the online psychology pool survey, a bogus question was included to ensure students were attending to the survey content. The following question was embedded within the measure of PTSD symptoms (the PCL-5): “Sometimes students do not always read and answers surveys carefully. To indicate that you are answering this survey carefully – answer ‘extremely’ to this question.” Participants’ responses to this question did not serve as an exclusion criteria for the

study, but the data from individuals' who did not respond to the item as instructed in the prompt was examined in detail.

Treatment history and ongoing outside treatment. Participants indicated if they had attended outside mental health treatment before, during, and after the study, what type of treatment they received (e.g., individual therapy, psychiatric medication management) and where they received treatment.

Traumatic events. The 17-item Life Events Checklist for the DSM-5 (LEC-5; Weathers et al., 2013) was used to determine if individuals have experienced a traumatic event that met Criterion A for PTSD. The LEC-5 includes a variety of different traumatic events including natural disasters, accidents, and interpersonal traumas (e.g., sexual assault). Individuals were considered to have experienced a traumatic event if they indicated the event had happened to them, they witnessed it, learned about it, or if they experienced it as part of their job. Question 17 "Any other very stressful event or experience" was a write in question and endorsement of this item only was not considered sufficient trauma exposure to be included in the study, in the absence of other traumatic events. The psychometric properties of the LEC-5 have not yet been published; previous versions of the LEC have demonstrated fair test-retest reliability (12 of the 17 items produced kappa coefficients of .40 or higher) and moderate convergent validity with another measure of trauma exposure (the average of the kappas for each item was .55) (Gray, Litz, Hsu, & Lombardo, 2004).

During the 2016 fall quarter recruitment period, researchers were asked to remove items from their studies in an attempt to reduce the length of the psychology screening survey, a shared resource among psychology researchers. Based on the rate of endorsement from previous quarters, the following three trauma exposure types were removed from the LEC-5 for fall

quarter: exposure to a toxic substance, combat or exposure to a war zone, and being held in captivity. Thus, the rates of trauma exposure for these three trauma types only reflect participant responses from Fall 2015, Winter 2016, and Spring 2016 quarters.

PTSD symptoms. PTSD symptoms were measured by the 20-item PTSD Checklist for the DSM-5 (PCL-5; Weathers et al., 2013). The PCL-5 asks how much an individual was bothered by a problem, ranging from 0 (*not at all*) to 4 (*extremely*) in the past month. Items reflect symptoms within each of the four PTSD symptom clusters of intrusion, avoidance, negative alterations in cognitions and mood, and alterations in arousal and reactivity. Participants were considered to be experiencing a PTSD symptom if they indicated they were bothered by that symptom "a little bit" (1) or more. A score of 33 has been proposed as a tentative cut-point for a PTSD diagnosis, pending further psychometric research (National Center for PTSD, 2017). The PCL-5 has demonstrated strong internal consistency ($\alpha = .94$), test–retest reliability ($r = .82$), and convergent (*rs* = .74 to .85) and discriminant (*rs* = .31 to .60) validity (Blevins, Weathers, Davis, Witte, & Domino, 2015).

Trauma-related negative cognitions. Trauma-related negative cognitions (e.g., "people can't be trusted", "there is something about me that made the event happen") were assessed using the 33-item Posttraumatic Cognitions Inventory (PTCI; Foa, Ehlers, Clark, Tolin, & Orsillo, 1999). Items on a Likert scale range from 1 "totally disagree" to 7 "totally agree". The PTCI total score had demonstrated strong test-retest reliability (*rs* = .86) and convergent validity (*rs* = .70 to .79) (Foa et al., 1999).

Drinking. *Heavy episodic drinking* was assessed with one item that asked participants if they had drank four or more drinks (for females) and five or more (for males) on one occasion – at least twice in the past month.

Drinking quantity was assessed via the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985). The DDQ has demonstrated modest convergent validity (r = .50) with other measures of college student drinking (Collins et al., 1985). Participants reported the average number of drinks they consumed each day of the past week. The quantity of alcohol consumed in the past week was measured by summing an individual's total drinks per day from this measure.

Drinking consequences were assessed via the 18-item Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 2000). Participants indicated how many times an event happened in the past month while they were drinking or because of their alcohol use (e.g., had a fight, argument or bad feelings with a friend; felt that you needed more alcohol than you used to use in order to get the same effect). The RAPI has demonstrated moderate convergent validity with alcohol use intensity (r = .20 to .57) and strong internal consistency (α = .92) in a sample of nonclinical adolescents (White & Labouvie, 1989). The 18-item version of the RAPI used in the current study highly correlates with the 23-item version (r = .99; White & Labouvie, 2000).

Drinking motives were assessed using the 20-item Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). The DMQ-R items are summed and categorized into four subscales representing different drinking motives: social (e.g., "because it makes social gatherings more fun"), coping (e.g., "to forget your problems"), enhancement (e.g., "because it gives you a pleasant feeling"), and conformity (e.g., "to fit into a group you like"). Confirmatory factor analysis has supported a four factor model of drinking motives over other models (MacLean & Lecci, 2000). The four subscales demonstrate good predictive validity (i.e., explain between 14 and 26 percent of the variance in drinking quantity, frequency, and drinking problems; Cooper, 1994) and the four subscales each demonstrates adequate internal reliability

(α range = .81-.94) (MacLean & Lecci, 2000).

Experiential avoidance. Experiential avoidance was assessed via the 7-item Acceptance and Action Questionnaire (AAQ-II; Bond et al., 2011). Questions on the AAQ-II (e.g., "emotions cause problems in my life"; "My painful experiences and memories make it difficult for me to live a life that I would value") range from 1 (*never true*) to 7 (*always true*). The AAQ-II has shown strong internal consistency (α = .84) and test-retest reliability (r = .81; Bond et al., 2011).

Self-compassion. Self-compassion was assessed using the 26-item Self-Compassion Scale (SCS; Neff, 2003b). The SCS items (e.g., "I'm disapproving and judgmental about my own flaws and inadequacies"; "When I fail at something that's important to me, I tend to feel alone in my failure") range from 1 (*almost never*) to 5 (*almost always*) and the measure has demonstrated good convergent (*r* = .41) and divergent (*r* = -.65) validity and test-retest reliability (*r* = .93; Neff, 2003b).

Depression. Given the high co-occurrence of PTSD and depression (Kessler et al., 2005), the revised version of the 20-item Center for Epidemiologic Studies Depression Scale (CESD-R; Eaton, Smith, Tien, Ybarra, 2004) was completed by participants at baseline. The CESD-R has demonstrated acceptable test-retest reliability (*r* = .57) and good concurrent validity (*r* = .60) and internal reliability (α = .87) (Radloff, 1977; Radloff, 1991).

Feasibility. Due to the pilot nature of this study, assessment of intervention feasibility was limited to the participant-level variables. Specifically, feasibility was assessed by a) the percentage of psychology subject pool students who met study criteria who then chose to participate in the study (a feasibility criteria of ≥80% of students meeting inclusion criteria who agreed to participate was chosen *a priori*), and b) responses on the Satisfaction and Acceptability

Questionnaire (see below) which assessed implementation barriers and facilitators including group timing, location, length, transportation issues, and open-ended questions to assess other potential barriers and facilitators to group participation.

Acceptability. Acceptability of the LKM group was assessed via the 14-item Satisfaction and Acceptability Questionnaire. This measure was based loosely on the Client Satisfaction Questionnaire (Larsen, Attkisson, Hargreaves, & Nguyen, 1979) and including questions about overall satisfaction, appealing and unappealing aspects of the group, and logistical barriers and facilitators to attending the group. Additionally, LKM group attendance rates were used as an indicator of acceptability.

Data Analysis

All analyses for the current study were conducted using SPSS, Version 19.0 statistical software (IBM, 2010).

Descriptive data analysis. Frequency distributions, measures of central tendency, and variation were examined for all demographic, baseline moderators, and outcome variables.

Inferential data analysis. LKM and RTAU were analyzed from an intent-to-treat perspective; data from all participants who enrolled in the study and were randomized to a condition were included, regardless of whether they initiated or continued treatment, or only provided baseline data.

Multi-level modeling (MLM) was chosen to evaluate change over time for PTSD symptoms, a continuous outcome variable. MLM was utilized because of the longitudinally clustered nature of the data; specifically, data from repeated measure observations were clustered within individuals over time (within-person, level 1) had the potential to confound comparisons of individuals assigned to the two conditions (between-person, level 2). Multilevel modeling has

several advantages over ordinary least squares regression. First, multilevel modeling does not require independence of observations; rather, it allows for and models variability within individuals as well as between individuals (e.g., over time and between conditions). Additionally, multilevel models account for missing data using full maximum likelihood estimation and do not require listwise deletion when data are missing. Thus, multilevel models can accommodate participants with missing data, so long as they contribute at least one data point.

For comparison of count outcomes (drinking quantity and negative drinking consequences), Generalized Estimating Equations (GEE; Liang & Zeger, 1986) were utilized. GEE is an extension of the generalized linear model, and can model outcomes with a variety of distributions. Distributions of count variables (non-negative integers) are often positively skewed when the mean is low, as is often the case when examining college student drinking where there are many zeros (e.g., individuals who do not consume alcohol at all). Simple transformation of count variables to make their distributions more normal makes interpretation difficult and leads to poorer model performance (O'Hara & Kotze, 2010); instead, it is recommended that models allow for alternative data distributions, such as the Poisson distribution (Atkins, Baldwin, Zheng, Gallop, & Neighbors, 2013). In the current study, drinking quantity and negative drinking consequences were modeled using the Poisson distribution. Regression coefficients from a Poisson model lie on a log scale, so coefficients are typically raised to the base of *e* and are interpreted as a rate ratio (Atkins et al., 2013). Rate ratios of 1.0 indicate no effect, while rate ratios above 1.0 indicate a percentage increase in the count outcome and rate ratios below 1.0 indicate a percentage decrease in the count outcome. Unlike multilevel models, GEE does not model within-subject variance; rather, GEE treats within-subject variance as error. Additionally,

while MLM is sensitive to covariance specification, GEE parameter estimates are not affected by misspecification of the covariance structure. Similar to multilevel models, GEE includes participants with incomplete data as long as they contribute at least one data point.

The MLM model and two models using GEE were built starting with the simplest model parameters (e.g., an empty model, which includes an intercept and residual only, no predictors) to the most complex (e.g., a fixed and random effects model in MLM). The fit for the MLM was compared using Bayesian Information Criterion (BIC; Schwarz, 1978) and the GEE models were compared using the Quasi Likelihood under Independence Model Criterion. The final "trimmed" models (Tables 10, 12, and 14) present the most parsimonious model with the best overall fit. Regarding interpretation of results, a significant effect of time suggested that participants' scores changed significantly over time, independent of condition assignment. A significant effect of condition suggested that participants' score in one condition significantly differed from participants in the other condition, independent of rate of change over time. A significant interaction between time and condition suggested participants' scores in one condition changed differently over time (i.e., faster or slower) than participants in the other condition (Ward-Ciesielski, 2015).

Exploratory mediation analysis was conducted using ordinary least squares regression, due to the complexity of interpreting mediation in MLM. The PROCESS macro, Version 2.16 for SPSS (Hayes, 2013), was used for the mediation analyses. The PROCESS macro generates a bootstrap confidence interval for the indirect effect of the mediator by randomly resampling from the data with replacement based on the study sample size, and estimates the indirect effect based on this bootstrap sample (Hayes & Rockwood, 2016). For the current study, 5,000 bootstrap samples were generated. Listwise deleted was used for the mediation analysis.

Covariance structure. Because MLM accounts for the within-person correlation of repeated measures data, the technique requires specification of a covariance structure that designates how repeated measure data are related. The covariance structure was determined analytically using BIC model fit indices (Schwarz, 1978). The variance components structure produced the best model fit for the MLM analyses. This covariance structure assumes all random effects are independent, the variances of random effects are assumed to the same, and that component variances sum to the variance of the outcome variable (Field, 2009). For the GEE analyses, the exchangeable (compound symmetry) covariance matrix was chosen to account for the within-person correlation in the data.

Centering. Time was not centered for these analyses, but instead coded to maximize interpretability of the parameter estimates (Biesanz, Deeb-Sossa, Papadakis, Bollen, & Curran, 2004). Time was coded as 0 at baseline and the other time points were coded 1 through 5, respectively, in order to examine patterns of change across the course of the study. Thus, the intercept estimates are for the baseline assessment.

Power analysis. Power to detect effects in multilevel models is influenced by a number of factors that makes estimation more complicated than estimating power in ordinary least squares regression models. Estimates of power to detect effects when using MLM is impacted by the presence of random effects, clustering of observations at Level 1, and varying sample sizes at Level 1 and 2 (Maas & Hox, 2005; Scherbaum & Ferreter, 2009). The software Optimal Design (Raudenbush et al., 2011) was used to estimate the power of the current study to detect effects *a priori*. Power was estimated to detect effects at level 1 (i.e., on primary outcomes of PTSD symptoms and drinking) by using the total expected number of observations (up to 6 observations per participant), while assuming an intraclass correlation coefficient of .45 (or that

45% of the variability in outcomes can be explained by between-individual differences), and a 90% completion rate for weekly assessments.

The Optimal Design sensitivity analysis indicated that with a target sample size of 118 participants, the study had power (1-β) = 0.8 to detect effects as small as Cohen's *f* = .06 at Level 1, although this estimate assumes that Level 1 effects are fixed or that the random effects are small, as power to detect effects falls off rapidly as the inter-individual variability in the Level 1 coefficients increases (Scherbaum & Ferreter, 2009). Given expected attrition of 20%, with a target sample size of 118 participants, the recruitment goal was determined to be 142 participants. However, due to fewer students meeting study inclusion criteria and slower recruitment than expected, the final sample size of 76 randomized participants (75 included in the analyses) was smaller than anticipated and resulted in reduced power to detect effects. Power to detect the hypothesized mediated effects are not estimated any differently than the power to detect simple main effects in multilevel models, with the caveat that the magnitude of most mediated effects are reported to be small (Fritz & MacKinnon, 2007). Thus, the study was likely underpowered to detect the hypothesized mediated pathways.

Post-hoc power analyses using the final sample size (*N*= 75) and the effect sizes found for the three main outcomes (ranging between Cohen's *f* = .11 to .28), indicated the study had power between .23 and .88, suggesting the study was moderately powered to detect the hypothesized main effects.

***Missing data*.** Missing data can be interpreted in three ways. Data considered to be missing completely at random (MCAR) assumes that the probability of a planned observation being missing is independent of the observed or missing data values. Data considered missing at random (MAR) assumes that the probability of planned observation being missing depends on

the observed data but not the missing data. Data considered missing not at random (MNAR) assumes the probability of a planned observation being missing is correlated with both the observed and missing data. Data for this study were considered to be MAR and can be considered "ignorable nonresponse" (Schafer & Graham, 2002). Most longitudinal studies have some wave nonresponse, including attrition, which occurs when an individual drops out of the study and does not contribute any more data (Schafer & Graham, 2002). MLM is appropriate when this type of attrition occurs, as it uses all of the available data for each participant, instead of removing participants with incomplete data (Schafer & Graham, 2002).

Effect sizes. An effect size was calculated for the three primary outcomes of interest – PTSD symptoms, drinking quantity, and negative drinking consequences. Effect sizes were calculated by subtracting the observed follow-up mean score from the observed baseline mean score and dividing the difference by the pooled standard deviation from these two time points. Cohen's *d* was used to categorize the size of the effect, with .2, .5, and .8 indicating small, medium, and large effects, respectively (Cohen, 1992).

Results

Sample characteristics. Seventy-six college students participated in the study (see Figure 1 for study flow diagram). One participant was removed from the analyses (see careless responder exclusion below), for a total of 75 participants included in the present analyses. The majority of study participants identified themselves as women (69.3%), heterosexual (88.0%), and white (56.0%), although there was considerable racial diversity among participants. Most participants were in their first year of college (57.3%) and the most common living arrangement was a fraternity or sorority house (34.7%). Participant demographics are summarized in Table 2. Regarding trauma exposure, the most frequently endorsed traumatic events experienced were a transportation accident (92.0%), unwanted or uncomfortable sexual experience (76.0%), and life-threatening illness or injury or physical assault (both 73.3%). The frequency of different types of traumatic events participants reported experiencing is summarized in Table 3. The means and standard deviations for the main outcome variables and proposed mediating variables at baseline, post-treatment, and follow-up are summarized in Table 4.

Careless responder exclusions. Three out of 76 participants (3.9%) endorsed an item other than specified in the prompt on the careless responder question embedded within the PCL-5 in the psychology screening survey. These participants' data were examined visually and one participant was deemed to have extreme scores (e.g., answering "extremely" to every question on the PCL-5 resulting max score of 80 at one time point), which likely indicated careless, fixed responding. Data from this individual were removed from all analyses.

Randomization check. Independent *t*-tests and chi-square tests revealed no significant difference between the LKM and RTAU condition groups with respect to participant gender, $\chi 2$ (1, $N = 75$) = .00, $p = .98$, or total PTSD symptom score at screening (t (73) = .72, $p = .47$),

indicating the minimization randomization protocol was successful. Additionally, no significant differences were found between the conditions on participant age, race, sexual orientation, total drinks per week, or total negative drinking consequences at baseline.

Outside treatment. At baseline, 12 participants (16.0%) reported receiving mental health treatment in the month before the study began. Eight participants (10.7%), four in the RTAU condition and four in the LKM condition, who indicated they had not received outside treatment before the study, subsequently indicated they had initiated treatment during the four weeks of the study. Chi-square tests revealed no significant difference between conditions on whether participants initiated a new treatment during the study, $\chi 2$ (1, N = 75) = .01, p = 1.0. Initiating a new outside treatment during the study was not related to baseline PTSD symptom scores (t (73) = -.39, p = .70), drinking quantity (t (70) = -.60, p = .55), or negative drinking consequences (t (71) = 1.3, p = .21). Table 5 summarizes outside treatment received before and during the study.

Attrition. Participants who provided data at baseline and no other time point were considered to have dropped out of the study. Out of 75 participants, 10 (13.3%) provided only baseline data; 65 participants (86.7%) provided data from at least at two waves. Independent t-tests and chi-square tests were used to compare participants who did and did not drop out of the study on baseline demographics, condition assignment, PTSD symptoms, drinking quantity, and drinking consequences to find any potential bias due to differential attrition (Table 6).

A significantly greater proportion of participants who dropped out of the study were in their second year of college, $\chi 2$ (1, N = 75) = 4.9, p = .04, and had more drinking consequences than those who did not drop out of the study (t (71) = -2.4, p = .02). A significantly greater proportion of participants who dropped out of the study were in the LKM condition (n = 8) than the RTAU condition (n = 2), $\chi 2$ (1, N = 75) = 4.7, p = .04. None of the participants who were

assigned to the LKM condition and who dropped out of the study (n = 8) attended a LKM group.

Feasibility of LKM Intervention

Feasibility of the intervention was assessed by a) the percentage of students who met study criteria who then agreed to participate in the study (a feasibility criteria of ≥80% of students meeting inclusion criteria who agreed to participate was chosen *a priori*) and b) responses on the Satisfaction and Acceptability Questionnaire (SAQ) regarding barriers and facilitators to attending the LKM group (Table 7).

A significant number of eligible students did not respond to email and phone invitations to participate in the study. Over the four school quarters during which data were collected, 346 PSS students met the initial study inclusion criteria and received email and phone invitation to participate. Of those students, six met subsequent exclusion criteria. Thus, a total of 340 PSS students were considered eligible for the study. Of these students, 76 (22.3%) provided informed consent to participate in the study, which fell below the *a priori* feasibility criteria of ≥80% of eligible participants.

Fifteen LKM participants completed the SAQ (Table 7). The three items most frequently endorsed as barriers to attending the LKM group were: inconvenient timing of group (26.4%), work commitments (20.0%), and inconvenient location of group (13.3%). The three items most frequently endorsed as facilitating group attendance were: on-campus location (60.0%), time of group (53.3%), and two items that were endorsed with equal frequency – email reminders and extra credit for the time spent on the project (both 46.7%).

Acceptability of LKM Intervention

Acceptability of the LKM group was assessed via the SAQ (responses summarized in Table 7), and group attendance. In response to the question “Overall, how would you rate your

satisfaction with the loving-kindness meditation group?" all respondents indicated they were somewhat satisfied (13.3%), satisfied (53.3%), or very satisfied (33.3%). When asked if they would recommend the LKM group to a friend who was experiencing similar difficulties as them, all respondents indicated yes, they thought they would (86.7%) or yes, definitely (13.3%). When asked about appealing features of the LKM group, the three items most frequently endorsed items were: group leaders (66.7%), on-campus location (60.0%), and time of group (60.0%). When asked about unappealing features, the four most frequently endorsed items were: time of group (26.7%), on-campus location (13.3%), and group length and homework practice (both 13.3%).

LKM group attendance was also used as an indicator of acceptability. Of the 36 participants randomized to the LKM condition, 14 (38.9%) did not attend any of the LKM groups, two (5.6%) attended one group, three (8.3%) attended two groups, seven (19.4%) attended three groups, and 10 (27.8%) attended all four groups. Participants were considered treatment completers if they attended two or more of the LKM groups, resulting in 20 (55.6%) of the participants randomized to the LKM condition considered treatment completers. LKM treatment completers and non-completers were compared on demographics and baseline PTSD symptoms, drinking quantity, and drinking consequences (Table 8). A significantly smaller proportion of the LKM non-completers were white compared to LKM completers, $\chi 2$ (1, $N = 35$) = 6.8, $p = .02$.

Relationships between variables at baseline. Bivariate correlations between baseline outcome variables, proposed mediators, and baseline moderators were examined to understand the direction and magnitude of their relationships (Table 9). All significant associations between variables were in the expected direction.

Longitudinal Outcomes

A MLM model and two models using GEE were created to predict the three main outcomes of interest: PTSD symptoms, drinking quantity, and drinking consequences (Tables 10 through 14).

Impact of intervention on PTSD symptoms. To examine the effect of time and condition on participants' total PTSD symptoms, an empty model was run, first with a fixed intercept and then with a random intercept. The random intercept was significant, suggesting it was appropriate to add and evaluate random effects in the model. Additionally, the intraclass correlation coefficient (ICC) was calculated, which indicates the amount of variance in the outcome determined by level 2 variables (e.g., between-person variables, such as demographics and condition assignment). The ICC calculation indicated that 65% of the variance in PTSD symptoms was due to differences between individuals, further suggesting that it was appropriate to test for random effects. The level 1 predictor of time was then entered into the model, first as a fixed, and then as a random effect, and a linear versus quadratic effect of time was compared. A linear effect of time best fit the data. The fixed effect of time was significant, 95% CI [-2.25, -0.53], and the estimate indicated that, on average, participants' total PTSD symptom score (as measured by the PCL-5) decreased by 1.39 points at each assessment time point. The effect size for the effect of time on PTSD symptoms from baseline to follow-up was medium (d = .63). Additionally, the random effect of time was significant, suggesting that the rate of change in individuals' PTSD symptoms over time (their slopes) differed between people. The level 2 predictor of condition was then added as a fixed effect and was non-significant, 95% CI [-9.21, 2.90], suggesting condition assignment did not predict level of PTSD symptoms. The effect size for the LKM and RTAU conditions from baseline to follow-up was medium (d = .66 and d =

.74). Finally, an interaction between time and condition was entered into the model as a fixed effect, and was non-significant, 95% CI [-1.86, 1.68], suggesting the change in PTSD symptoms over time was not significantly related to condition assignment. When the interaction term was added to the model, the main effect of time was no longer significant, likely due to the high multicollinearity time and the interaction between time and condition (r = .86). Adding each predictor improved model fit and the final model is depicted in Table 10.

Impact of intervention on drinking quantity. Similar to the MLM analyses, time was entered first into the GEE model, and a linear versus quadratic effect of time was compared. A linear effect of time resulted in better model fit. Condition was then entered into the model, followed by an interaction between time and condition. GEE analyses revealed a significant effect of time, rate ratio = .90, 95% CI [-0.17, -0.06]), indicating a 10% decrease in total drinks per week over the study. The effect size for the effect of time on drinking quantity from baseline to follow-up was small (d = .21). There was no significant effect of condition, rate ratio = .98, 95% CI [-0.27, 0.22], or time by condition interaction, rate ratio = .74, 95% CI [-0.15, 0.09], suggesting that participants' drinking quantity was not significantly different between the conditions, and their decrease in drinking over time was not significantly related to condition assignment (Table 11). The effect size from baseline to follow-up was small for LKM (d = .09) and medium for RTAU (d = .41). Including the interaction term in the model resulted in the main effect of time no longer being significant, likely due to the to the high multicollinearity between the time and the interaction between time and condition (r = .86). Adding each predictor improved model fit, except for the interaction between time and condition, which worsened model fit. Thus, the interaction between time and condition was subsequently trimmed from the final model to improve model fit (Table 12).

Impact of intervention on negative drinking consequences. GEE analyses revealed a significant effect of time, rate ratio = .74, 95% CI [-0.49, -0.12], which indicated a 26% decrease in drinking consequences over the course of the study. The effect size for the effect of time on drinking consequences from baseline to follow-up was medium (d = .55). There was no significant effect of condition, rate ratio = 1.22, 95% CI [-0.10, 0.50], or time by condition interaction, rate ratio = .84, 95% CI [-0.39, 0.35], suggesting that participants' drinking consequences were not significantly different between the conditions, and their decrease in negative drinking consequences over time was not significantly related to condition assignment (Table 13). The effect size for the LKM and RTAU conditions from baseline to follow-up was medium (d = .70 and d = .41). Including the interaction term in the model resulted in the main effect of time no longer being significant, likely due to the to the high multicollinearity between time and the interaction between time and condition (r = .88). As with the GEE model for drinking quantity, adding each predictor improved model fit except for the interaction between time and condition, which worsened model fit. Thus, the interaction between time and condition was subsequently trimmed from the final model to improve model fit (Table 14).

Baseline moderators. Participants' baseline depression score and drinking motives were added as baseline moderators to the models predicting PTSD symptoms, drinking quantity, and negative drinking consequences.

Regarding PTSD symptoms, participants' baseline depression significantly predicted PTSD symptoms over time, 95% CI [0.17, 1.08], such that for a one point increase in depression score on the CESD, participants' PTSD symptom score increased by 0.62 points. Additionally, participants' coping drinking motives significantly predicted PTSD symptoms over time, 95% CI [0.97, 2.58], such that for a one point increase in coping motives, participants' PTSD symptom

score increased by 1.78 points.

Regarding drinking quantity, participants' social drinking motives significantly predicted total drinking quantity, rate ratio = 1.09, 95% CI [0.04, 0.14], indicating a 9% increase in drinking quantity over the course of the study. Regarding negative drinking consequences, participants' coping drinking motives significantly predicted negative drinking consequences, rate ratio = 1.08, 95% CI [0.04, 0.12], indicating a 8% increase in drinking consequences over the course of the study.

Mediation analyses. The change in experiential avoidance, negative cognitions, and self-compassion from baseline to post-treatment were examined to see if they mediated the effect of condition on change in PTSD symptoms, problem drinking, and negative drinking consequences from baseline to follow-up. Although no direct effect of condition was found on the main outcome variables, it was possible that inconsistent mediating effects were present. Specifically, inconsistent mediation models occur when at least one mediated effect has a different sign than the other mediated or direct effects in a model (MacKinnon, Fairchild, & Fritz, 2007) and opposing mediation occurs when two indirect effect on the same outcome are approximately equal in size but opposite in sign. This can occur when two different mediating variables counteract each other, or if a single mediator variable leads to decreases in the outcome variable for some individuals and increases in the outcome variable for other individuals. Thus, theoretically, mediation could still be taking place via opposing mediation processes, which would cancel out the direct effect of condition.

Experiential avoidance. There was no significant indirect effect of baseline to post-treatment change in experiential avoidance on baseline to follow-up change in PTSD symptoms, b = .14, 95% CI [-1.30, 3.95], drinking quantity, b = .41, 95% CI [-.46, 3.16], or negative

drinking consequences, *b* = -.02, 95% CI [-.87, .41].

Negative cognitions. There was no significant indirect effect of baseline to post-treatment change in negative cognitions on baseline to follow-up change in PTSD symptoms, *b* = -.23, 95% CI [-4.10, 1.21], drinking quantity, *b* = .93, 95% CI [-.49, 4.05], or negative drinking consequences, *b* = .86, 95% CI [-.15, 3.50].

Self-compassion. There was no significant indirect effect of baseline to post-treatment change in self-compassion on baseline to follow-up change in PTSD symptoms, *b* = .07, 95% CI [-2.12, 4.00], drinking quantity, *b* = .19, 95% CI [-.55, 2.22], or negative drinking consequences, *b* = .44, 95% CI [-.37, 3.01].

Discussion

This study evaluated the feasibility, acceptability, and effectiveness of a 4-week group loving-kindness meditation intervention (LKM) for college students with PTSD symptoms and problem drinking, compared to referral to treatment as usual (RTAU). This is the first study to evaluate LKM for co-occurring PTSD symptoms and problem drinking in the college population, and utilized a randomized controlled design.

Two primary hypotheses were tested: 1) implementing LKM would be feasible and college students would find the intervention acceptable; and 2) participants who received LKM would experience significantly greater reductions in PTSD symptoms, drinking quantity, and negative drinking consequences, compared to RTAU.

Feasibility of group LKM. Feasibility was assessed using participant-level variables, including recruitment into the study and responses to questions about LKM participation barriers and facilitators. Only 22 percent of college students who met study criteria chose to participate in the study, which fell below the *a priori* feasibility criteria of ≥80% of eligible students choosing to participate in the study. Thus, the study, as implemented, failed to enroll a large percentage of eligible college students.

Lower-than-anticipated recruitment could have several potential explanations. Students were enrolling in a randomized trial rather than simply agreeing to a treatment and some may have found random assignment, rather than the treatment, to be unacceptable. Study participation also required a substantial time commitment (6 hours, including informed consent and assessment completion) that was longer than other studies being offered to psychology subject pool students. To the extent that students were motivated primarily by course credit awarded for participation, this study may have been perceived as too burdensome and time intensive, and eligible students may have elected to receive credit by participating in less time intensive studies

instead.

It is also possible that students were reluctant to take part in a study focused on treatment. Given that participants were recruited from a non-clinical setting (i.e., the psychology subject pool), students may not have considered themselves in need of treatment to manage their PTSD symptomatology or address their drinking behavior. Previous research in college student populations has identified students' lack of perceived need for care as one barrier to accessing treatment (Hunt & Eisenberg, 2010).

Finally, efforts to reach potential participants may have been insufficient. Study research assistants made three phone calls and sent three email messages to students who met the initial inclusion criteria from the psychology screening survey. Such efforts to recruit students are in line with what might be offered in college communities offering programs such as this to students, but may have not have been vigorous or intensive enough to enroll the majority of students. Of note, many students did not provide complete or accurate contact information, which made contacting all potential participants difficult.

Additional insight into feasibility issues was provided by participants' reports of barriers and facilitators to attending LKM groups. The three most frequently endorsed barriers to attending the group included the time it was held, its location, and competing participant work commitments. Practical barriers to attending psychotherapy are commonly reported (e.g., Mohr et al., 2006) and remain an important consideration when designing and delivering interventions. LKM groups were offered in the late afternoon to avoid potential class conflicts; however, this time of day may not be ideal for students who work in the afternoon or evenings. Although several participants reported the time and location as making it more difficult to attend, the on-campus location and timing of the group were reported as facilitators of group attendance by a

greater number of participants. The most commonly endorsed facilitators were the on-campus location, time of group, email reminders, and extra credit for time spent on the project. Feasibility of psychotherapy group interventions for a college population might be improved if sessions are offered at a variety of the times (e.g., one morning group and one evening group) and, potentially, in a variety of locations.

Additionally, it appears that students found email reminders, a relatively low-effort tool, helpful in facilitating their group attendance. Interestingly, fewer participants reported that phone call reminders were useful, although it is common in mental health practice to remind individuals of appointments over the phone. Email communication is often discouraged because of privacy concerns, but if individuals find this form of communication acceptable and agree to be contacted via email (as they did in this study), this method of communication may be preferable to telephone reminders. Additionally, while not utilized in this study, text message reminders are another increasingly popular form of communication, and have resulted in better attendance rates among adolescents for outpatient mental health appointments (Branson, Clemmey, & Mukherjee, 2013).

Participants reported that the extra credit they received for their participation in the study facilitated their group attendance. This finding suggests that participants may have been motivated to attend LKM groups, at least in part, by the course credit they received. Thus, the LKM group attendance rates in this study may not generalize to a non-research context where incentives for participation are not offered. Alternatively, this finding might also suggest that external reinforcers may be useful in encouraging mental health appointment attendance among non-treatment seeking college students. Strategies that focus on rewarding individuals for attending therapy sessions or abstaining from using substances, such as contingency

management, have been efficacious in clinical samples of individuals with substance use disorders (e.g., Prendergast, Podus, Finney, Greenwell, & Roll, 2006), and may generalize to a non-clinical population as well. In a study of brief motivational interviewing for college students with heavy drinking, adding a therapy session focused on increasing the salience of delayed natural reinforcers (e.g., academic and career rewards) resulted in fewer subsequent drinking consequences than motivational interviewing plus relaxation training (Murphy et al., 2012). These practices stand in contrast to more punitive methods utilized by some institutions to increase mental health counseling attendance. For example, many colleges mandate that students attend alcohol education classes or counseling if they violate the college's drinking policies (Barnett & Read, 2005), and there are often negative consequences (e.g. academic probation) for failure to attend the mandated treatment. Reinforcement strategies to encourage attendance at mental health appointments may be more effective than punitive measures for students who are not actively seeking treatment.

Acceptability of group LKM. Acceptability was assessed via self-report and by rates of LKM group attendance. All participants who completed the Satisfaction and Acceptability Questionnaire (n=15) indicated they were at least somewhat satisfied with the intervention, and the majority (86.6%) reported they were satisfied or very satisfied. Additionally, all participants reported they would likely recommend the LKM group to a friend who was experiencing similar difficulties. Only one individual reported the group format (as opposed to individual format) was unappealing, while eight participants endorsed the group format as an appealing feature. This suggests that college students who attended the sessions largely found LKM acceptable when delivered in a group format.

The Satisfaction and Acceptability Questionnaire was administered online as part of the

post-treatment assessment, to reduce demand characteristics on participants. However, it is possible that participants responded in an overly positive manner due to an awareness that researchers were evaluating LKM and a supposition that investigators were seeking a positive result. Additionally, only 15 participants (out of the 36 randomized to LKM) completed the Satisfaction and Acceptability Questionnaire. Individuals who were not satisfied with the LKM group may have disproportionately elected not to complete the questionnaire, resulting in a positive bias among responders.

LKM group attendance represented a second method for assessing acceptability; interventions that are more acceptable to subjects are likely to be better attended. Twenty participants (55.6%) attended at least half of the LKM groups. It is unclear how this attendance rate compares to other groups for non-treatment seeking college students, as these rates are not widely reported. In clinical samples of individuals with PTSD and alcohol dependence, where motivations to seek treatment are presumably greater, treatment dropout is high (e.g., median number of sessions attended in concurrent treatment for PTSD and SUD was 5 out of 13; Mills et al., 2012). More generally, premature withdrawal from therapy has been a consistent issue in mental health treatment, with a third of individuals dropping out after the first session and many others before receiving the full benefit of treatment (Barrett, Chua, Crits-Christoph, Gibbons, & Thompson, 2008). Importantly, a substantial number of participants (38.9%) did not attend any of the LKM groups, and their reasons for lack of attendance are unknown. Complete non-attendance may have resulted from feasibility issues (conflicts with the time and day the LKM group was offered), or not perceiving a need for help (Hunt & Eisenberg, 2010). Alternatively, complete non-attendance may have resulted from unacceptability of, or a general lack of interest

in, the group LKM intervention. While feasibility and acceptability represent different constructs, in practice it can be difficult to distinguish between the two.

Additionally, it is important to note that a greater proportion of the LKM completers were white compared with non-completers, and more non-white individuals did not complete the LKM intervention than completed it. Thus, it is possible that the group LKM may not have been acceptable to participants of color. Participants of color may have not felt comfortable in a group therapy with majority of white participants and white group leaders. Alternatively, aspects of LKM (e.g., direct expression and discussion of compassion) may be inconsistent with participants of color's cultural values and norms. Previous research indicates that mindfulness interventions have been found acceptable by minority populations (e.g., Dutton, Bermudez, Matás, Majid, & Myers, 2013; Szanton, Wenzel, Connolly, & Piferi, 2011); however, more work is needed to explain the racial disparities in LKM completion and to improve the inclusiveness of this intervention strategy.

The responses of those who did participate in the LKM group suggest that the intervention – despite being somewhat unusual in that it consists of repeating phrases of positive intention to oneself and others – appears to be acceptable to college students. This may reflect the increasing exposure to and acceptance of mindfulness practices in popular culture in the United States more generally. Nevertheless, attendance at LKM groups was moderate and a significant minority of individuals did not attend any of the LKM groups, suggesting a need to better understand the disparity between these two indices of acceptability.

Intervention outcomes. The second hypothesis – that participants who received LKM would experience significantly greater reductions in PTSD symptoms, drinking quantity, and negative drinking consequences at post treatment and 1-month follow-up compared to RTAU –

was not supported. Rather, a significant effect of time, but not condition, was found for the three main outcomes. In other words, participants experienced decreases in PTSD symptoms, drinking quantity, and negative drinking consequences over the course of the study, irrespective of their treatment condition. However, when the interaction between time and condition was entered into the models, the main effect of time was no longer significant, likely due to the to the high multicollinearity between the variables of time and interaction between time and condition.

There are a number of reasons why the LKM condition may not have demonstrated differential benefit above the RTAU condition in this study. First, the study sample was comprised of a non-treatment seeking sample of college students who demonstrated a moderate level of PTSD symptoms, below diagnostic threshold for a clinical diagnosis of PTSD. In part, the study inclusion criteria were kept broad in order to be able to determine the effects of LKM in a nonclinical sample. However, LKM may not be effective for individuals with subthreshold levels of PTSD symptomatology. Additionally, a substantial number of participants randomized to the LKM condition did not attend any of the LKM groups, potentially diluting LKM treatment effects.

Thirdly, treatment fidelity in the current study may have been compromised. The LKM intervention was delivered by graduate students who, despite training in and experience with mindfulness-based practices, were new to LKM treatment delivery. Thus, the graduate student leaders were simultaneously learning how to best facilitate the LKM groups while the study was ongoing and data were being collected. While a clinical psychologist with expertise in mindfulness reviewed the audio files of the LKM group and provided weekly supervision to group leaders, fidelity to the LKM intervention was not directly assessed. In contrast, in Kearney and colleagues' 2013 study of LKM for veterans with PTSD, a trained meditation teacher who

specialized in LKM led the intervention. Thus, it is unclear if the skill level of the LKM group leaders, and the degree to which they delivered the LKM intervention as intended, influenced the effectiveness of group LKM.

Fourth, increased engagement and buy-in from participants may have also increased LKM's effectiveness. While participants were aware of why they met study inclusion criteria (e.g., had PTSD symptoms and engaged in heavy episodic drinking at least twice in the past month), the LKM intervention, similar to other mindfulness interventions (e.g., Cherkin et al., 2016), did not focus on a particular condition or behavior. Thus, participants in the LKM condition may not have made a connection between the LKM exercises and their PTSD symptoms and drinking behavior. While providing rationales in therapy can lead to psychotherapeutic demand characteristics (Kanter, Kohlenberg, & Loftus, 2004), they can also lead to greater participant understanding and increased engagement, thereby potentially enhancing treatment efficacy.

Fifth, the 4-week LKM intervention in the current study was a compressed version of the 12-week intervention from Kearney and colleagues' (2013) study. It is possible that the "dose" of LKM in the current study, including group time devoted to practicing the exercises and discussing the participants' experiences with the exercises, was not sufficient. Students may need extended practice and discussion of the LKM exercises in order to reap their full benefit.

Finally, group LKM may simply not be an effective intervention for college students with PTSD symptoms and problem drinking; thus, no effect would have been demonstrated even if the issues outlined above had been addressed. While there has been increasing interest in mindfulness-based approaches to PTSD treatment recently (e.g., Talkovsky & Lang, 2017), the current study raises the possibility that mindfulness interventions such as LKM may not be

effective for individuals with subthreshold PTSD symptoms and problem drinking within a college population. LKM is a relatively non-directive intervention, and while group LKM does provide the opportunity to discuss thoughts and feelings that result from the meditation exercises, group leaders do not engage individuals in extended conversations about their trauma experiences or trauma-related cognitions. College students may need a more directive intervention to be able to effectively challenge and modify certain post-traumatic cognitions (e.g., "I can't stop bad things from happening to me") and shift related emotions (e.g., fear, shame). Additionally, students may not have connected their PTSD symptoms with their drinking behavior (e.g., drinking to cope), and so may not have viewed their drinking as problematic or in need of change. Students may need more explicit psychoeducation and discussion about their drinking, including how their drinking may relate to to their PTSD symptoms, in order to enhance their understanding and ability to modify this behavior. Although mindfulness interventions are promising, it is important for researchers to take note of studies with null results to avoid exacerbating the "file drawer problem" (Rosenthal, 1979), in which studies with significant findings are prioritized and published while studies with null results are stashed away.

Symptom change over time. Participants experienced a significant decrease in PTSD symptoms, drinking quantity, and negative drinking consequences over the course of the study. The effect of time was small to medium. One explanation for this improvement is that the repeated assessment itself was actually therapeutic. Several studies have noted that participants seem to derive benefit from assessment, even in the absence of any intervention (e.g., Epstein et al., 2005; Kypri, Langley, Saunders, & Cashell-Smith, 2007). The non-judgmental manner in which assessments were administered may have helped participants reflect on, and change,

patterns of behavior that might otherwise have gone unexamined. Alternatively, participants' improvement over time might have resulted not from any specific therapeutic effect of assessment, but rather from transient activation and performance enhancement that accompanies the process of being observed (i.e., the Hawthorne effect), or from participant's knowledge that they were part of a research study, which may have led to beliefs about the researcher expectations and responses in line with these expectations (i.e., demand characteristics).

Another interpretation of the decrease in PTSD symptoms, drinking quantity, and negative drinking consequences over the course of the study is simple regression to the mean, or the tendency of individuals' scores in an extreme group to be closer to the population mean when reassessed (Bland & Altman, 1994). This shift in scores may be due to genuine variability in individuals' symptoms over time or to random measurement error of the observed variables. In this study, individuals met the inclusion criteria if they were engaging in heavy episodic drinking (by definition, an elevated level of drinking, although frequent in college students) and were experiencing at least a mild level of PTSD symptoms at the time they responded to the psychology screening survey. Thus, individuals may have been selected for the study because they were at a particularly extreme point in their trajectory of PTSD symptomatology and drinking behavior; with repeated measurement these individuals' symptoms will appear to have moved closer towards their own individual mean (e.g., personal average level of drinking and PTSD symptoms), which will also be closer to the population mean. Thus, we could expect to see a decrease in participants' PTSD symptoms and drinking over a course of repeated assessment as a statistical phenomenon, rather than a result of intervention, assessment, or expectancy effects (Finney, 2008).

Mediators of LKM intervention. Changes in experiential avoidance, negative

cognitions, and self-compassion from baseline to post-treatment did not mediate the effect of LKM on changes in PTSD symptoms, problem drinking, and negative drinking consequences from baseline to follow-up. This finding stands in contrast to the open trial of LKM, which found that changes in self-compassion significantly mediated changes in PTSD symptoms between baseline and post-treatment and between baseline and 3 months post-treatment (Kearney et al., 2013). The absence of any mediation effects may be explained by the lack of LKM treatment effect (e.g., participants' change over time in LKM may have been due to regression to the mean rather than treatment effect). It is possible that if LKM had a stronger treatment effect, changes in experiential avoidance, negative cognitions, and self-compassion may have mediated that effect. It is also possible that mediation effects were actually present in the current study, but the study's power was too low to detect these effects.

Drinking motivation and PTSD symptomatology. Participants' drinking motives significantly predicted PTSD symptoms, drinking quantity, and negative drinking consequences. Specifically, higher coping drinking motives predicted greater PTSD symptoms and more drinking consequences, while social drinking motives predicted greater drinking quantity. These findings are consistent with previous research that, while college students who drink to cope may consume less than those who drink for social facilitation (Read et al., 2003), they experience more alcohol-related consequences than those who drink for other reasons (e.g., Kuntsche et al., 2005; Cooper, 1994). Students who drink to cope may drink in ways that impair their day-to-day functioning (e.g., drinking in the morning before classes) and they may have fewer protective factors (e.g., trusted peers ensuring they get home safely) than those who drink for social facilitation reasons, who likely drink in social settings.

Additionally, higher coping drinking motives predicted greater PTSD symptoms at

follow-up. This finding suggests that drinking to cope exacerbates PTSD symptoms, and potentially makes PTSD symptoms less receptive to intervention. Such an effect could result from the negative reinforcement cycle that substance use perpetuates: alcohol can temporarily dampen PTSD symptoms, which leads to continued alcohol use, which in turn interferes with natural or intervention-mediated recovery from PTSD symptomatology. If this is indeed the case, early effective intervention for individuals who drink to cope with their PTSD symptoms continues to be critically important to disrupt that cycle.

Outside treatment. A minority of participants in the RTAU condition (10.2%) initiated a new outside treatment during the course of the study. Thus, the RTAU condition may be more accurately conceptualized as a repeated assessment control condition. Providing a list of low-cost or free mental health services on campus and in the community does not appear to lead to a large number of individuals initiating new treatment. The findings in the current study are consistent with a general trend of college students who screen positive for mental health disorders not receiving mental health services (Eisenberg, Golberstein, & Gollust, 2007). Colleges that have psychology subject pools may want to consider more intensive referral methods (e.g., sending personalized emails with feedback about their mental health and providing referrals) for students who screen positive for mental health issues and problem drinking.

Limitations. There were several limitations to this study. Some of these limitations were related to data collection:

First, participants' trauma exposure and PTSD symptoms were assessed via self-report. Self-report can be problematic because individuals will often endorse experiencing a "traumatic" event or "PTSD" symptoms that would not meet diagnostic criteria for trauma or PTSD if assessed by a trained mental health professional.

Secondly, there is some evidence that the measure used in the current study to assess PTSD symptoms, the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5; Blevins et al., 2015), may lead to an overestimation of PTSD symptomatology and may not be specific enough to detect symptoms unique to PTSD. For example, one study found high false positive rates (65-76%) in categorizing National Guard veterans with PTSD when the PCL-IV was used as the sole measure of symptoms (Arbisi et al., 2012). In the same study, a measure of depression performed equally as well as the PCL-IV in identifying veterans diagnosed with PTSD via structured clinical interview, suggesting PCL scores may reflect generalized distress rather than symptomatology specific to PTSD (Arbisi et al., 2012).

Lastly, the PTSD symptom threshold for inclusion in the current study was low in order to capture college students who were experiencing at least some distress related to a traumatic event. However, some of these individuals may have been functioning relatively well and not in need of an intervention aimed at reducing their modest level of PTSD symptomatology.

There were also limitations related to LKM intervention delivery. Although participants were given a guided LKM meditation audio file and encouraged to practice the LKM exercises during the week, homework completion (e.g., practicing the LKM exercises outside of the group) was not directly assessed. Between-session mindfulness practice has been found to be related to increased mindfulness skills after mindfulness-based interventions (Bowen & Kurz, 2012; Carmody & Baer, 2008), and increases in mindfulness skills mediate the relationship between mindfulness practice and improvements in psychological functioning (Carmody & Baer, 2008), suggesting between-session practice is an important component through which individuals learn mindfulness and reap the benefits from mindfulness-based interventions. Because between-session mindfulness practice was not assessed, we do not know how often participants in the

LKM condition practiced the exercises and if and how between-session practice was related to PTSD symptom and drinking outcomes.

In addition, as noted above, the LKM intervention was delivered by graduate students who, despite training in and experience with mindfulness-based practices, were new to LKM treatment delivery. Thus, the graduate student leaders were simultaneously learning how to best facilitate the LKM groups while the study was ongoing and data was being collected. Moreover, while a clinical psychologist with expertise in mindfulness reviewed the audio files of the LKM group and provided weekly supervision the group leaders, fidelity to the LKM intervention was not directly assessed.

Finally, sampling limitations were also present. The sample size of the study was smaller than anticipated, which resulted in less power to detect differences between the conditions. Substantial attrition over the course of the study further reduced the ability to detect effects.

Future Directions

Despite the limitations summarized above, the current study represents the first randomized controlled trial of group LKM as an intervention for college students with PTSD symptoms and problem drinking. Although the intervention was not associated with reductions in PTSD symptomatology, drinking quantity, or negative drinking consequences beyond those of RTAU, the study revealed several opportunities to improve feasibility and acceptability of a group LKM intervention in the college population. For example, delivering treatment in a group format, leveraging multiple forms of student outreach, and offering students convenient times and locations for treatment may facilitate engagement and completion of treatment.

Future research that addresses the limitations of the current study, such as extending the length of the LKM intervention, monitoring LKM treatment fidelity, and assessing between-

session LKM practice may improve outcomes and should be considered. Alternatively, other low-cost, accessible treatments for college students with PTSD symptoms and problem drinking should be evaluated. Specifically, interventions that address the needs of college students who drink to cope with their PTSD symptoms is critical, as there is evidence from the current study that coping drinking motives lead to greater PTSD symptoms and more negative drinking consequences. Students who drink to cope with PTSD symptoms may benefit from an intervention that focuses on the function of their drinking and both ameliorates PTSD symptoms while teaching individuals other, more adaptive ways to cope with these symptoms. Successfully treating individuals during college will allow them the opportunity to transition into adulthood with a greater capacity to lead meaningful and rewarding lives.

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Table 1

Study Measures and Assessment Schedule

	Screening Survey	In person meeting	Baseline	Weekly during study	Post-treatment	1-month follow-up
Demographics	X					
Life Events Checklist for DSM-5	X					
PTSD Checklist for DSM-5	X			X	X	X
Heavy Episodic Drinking	X					
P4 suicide screener		X				
Behavior and Symptom Identification Scale		X				
Daily Drinking Questionnaire			X	X	X	X
Acceptance and Action Questionnaire			X	X	X	X
Rutgers Alcohol Problems Index			X	X	X	X
Posttraumatic Cognitions Inventory			X	X	X	X
Self-Compassion Scale			X	X	X	X
Drinking Motives Questionnaire			X			
Center for Epidemiologic Studies Depression Scale			X			
Satisfaction and Acceptability Questionnaire (LKM group)					X	

Table 2

Participant Baseline Demographics (N = 75)

Demographic	%
Women	69.3
Age (M (SD))	19.2 (1.3)
Sexual orientation	
Straight	88.0
Gay	6.7
Bisexual	2.7
Questioning	2.7
Race/ethnicity	
White	56.0
Asian/Pacific Islander	20.0
Mixed race	17.3
Latino	5.3
Black	1.3
Year in School	
1st year	57.3
2nd year	22.7
3rd year	16.0
4th year	4.0
Residence	
Fraternity or sorority house	34.7
Campus residence hall	30.7
Off-campus apartment or house	30.7
At home with parents	4.0

Table 3

Types of Trauma Exposure Reported by Participants (*N* = 75)

Trauma Type	% Experienced (*n*)
Natural disaster (for example, flood, hurricane, tornado, earthquake)	72.0 (54)
Fire or explosion	67.1 (51)
Transportation accident (for example, car accident, boat accident, train wreck, plane crash)	92.0 (69)
Serious accident at work, home, or during recreational activity	66.6 (50)
Exposure to toxic substance (for example, dangerous chemicals, radiation)[+]	18.7 (14)
Physical assault (for example, being attacked, hit, slapped, kicked, beaten up)	73.3 (55)
Assault with a weapon (for example, being shot, stabbed, threatened with a knife, gun, bomb)	57.3 (43)
Sexual assault (rape, attempted rape, made to perform any type of sexual act through force or threat of harm)	69.3 (52)
Other unwanted or uncomfortable sexual experience	76.0 (57)
Combat or exposure to a war-zone (in the military or as a civilian)[+]	20.0 (15)
Captivity (for example, being kidnapped, abducted, held hostage, prisoner of war)[+]	9.3 (7)
Life-threatening illness or injury	73.3 (55)
Severe human suffering	52.0 (39)
Sudden violent death (for example, homicide, suicide)	54.7 (41)
Sudden accidental death	57.3 (43)
Serious injury, harm, or death you caused to someone else	14.7 (11)

Note. Participants were considered to have experienced each traumatic event if they indicated it had happened to them, witnessed it, or learned about it on the Life Events Checklist for DSM-5. [+]Participants recruited during Fall quarter 2016 (*n* = 38) were not asked about these traumatic experiences due to psychology screening survey length.

Table 4

Main Outcomes and Proposed Mediators At Baseline, Post-treatment, and Follow-up (N = 75)

	Condition			
	LKM		RTAU	
	n	**M (*SD*)**	***n***	**M (*SD*)**
PCL-5 Total Score				
Screen	35	22.8 (14.6)	39	25.6 (18.0)
Post-treatment	18	16.1 (16.8)	31	18.0 (18.9)
1 month follow-up	16	13.4 (14.4)	24	13.5 (14.1)
DDQ Total Drinks Past Week				
Baseline	35	10.0 (6.2)	37	9.8 (8.1)
Post-treatment	18	3.0 (4.7)	29	5.9 (6.4)
1 month follow-up	19	9.1 (11.4)	28	6.8 (6.1)
RAPI Total Score				
Baseline	34	7.2 (4.9)	39	5.9 (5.3)
Post-treatment	17	5.2 (8.5)	33	2.9 (3.5)
1 month follow-up	18	3.9 (4.5)	28	3.7 (5.4)
PTCI Total Score				
Baseline	33	82.7 (29.4)	37	86.1 (39.7)
Post-treatment	16	67.5 (39.4)	33	82.3 (48.7)
1 month follow-up	17	78.8 (41.2)	25	71.2 (41.1)
SCS Total Score				
Baseline	35	74.5 (13.4)	38	77.2 (16.7)
Post-treatment	18	79.0 (11.4)	31	81.8 (12.8)
1 month follow-up	16	83.5 (11.2)	26	78.1 (13.7)
AAQ-II Total Score				
Baseline	35	21.7 (7.7)	39	23.7 (9.5)
Post-treatment	17	16.2 (8.3)	32	19.7 (11.2)
1 month follow-up	18	18.6 (8.9)	29	20.1 (11.0)

Note. PCL-5 = PSTD Checklist for DSM-5; DDQ = Daily Drinking Questionnaire; RAPI = Rutgers Alcohol Problem Index; PTCT = Posttraumatic Cognitions Inventory; SCS = Self-Compassion Scale; AAQ-II = Acceptance and Action Questionnaire.

Table 5

Treatment Received Outside of Study

	Condition			
	LKM		RTAU	
	n	**%**	***n***	**%**
Received outside treatment in month before study	3	8.3	9	23.1
Received outside treatment during four weeks of study	7	19.4	9	23.1
New course of outside treatment initiated during four weeks of study	4	11.1	4	10.3
Type of outside treatment received in month before study				
Individual psychotherapy	2	5.6	7	17.9
Group therapy	0		0	
Psychiatric medication	0		2	5.1
Substance use counseling	0		0	
Other	1	2.8	0	
Did not report	0		0	
Type of outside treatment received during study if new onset				
Individual therapy	0		0	
Group therapy	0		1	2.6
Psychiatric medication	0		1	2.6
Substance use counseling	1	2.8	0	
Other	0		1	2.6
Did not report	3	8.3	1	2.6

Table 6

Baseline Characteristics by Study Dropout Status (N = 75)

	Dropped out (*n*=10)	**Did not drop out (*n*=65)**		
	%	**%**	**χ2 / *t***	***p***
Women	50.0	72.3	2.0	.15
Age (M (SD))	19.0 (.94)	19.2 (1.4)	.47	.64
Sexual orientation				
Straight✚	80.0	89.2		.34
Gay✚	10.0	6.2		.52
Bisexual✚	0.0	3.1		1.0
Questioning✚	10.0	1.5		.25
Race/ethnicity				
White	50.0	56.9	.17	.68
Asian/Pacific Islander✚	10.0	21.5		.68
Mixed race✚	10.0	18.5		1.0
Latino✚	20.0	3.1		.08
Black✚	10.0	0.0		.13
Year in School				
1st year	50.0	58.5	.25	.74
2nd year	50.0	18.5	4.9	.03*
3rd year✚	0.0	18.5		.35
4th year✚	0.0	4.6		1.0
Residence				
Fraternity or sorority house✚	40.0	33.8		.73
Campus residence hall✚	40.0	29.2		.48
Off-campus apartment or house✚	20.0	32.3		.71
At home with parents✚	0.0	4.6		1.0
Assigned to LKM condition✚	80.0	43.1		.04*
PTSD Symptoms (PCL-5) (M (SD))	28.2 (15.5)	23.6 (16.6)	-.82	.42
Total Drinks Past Week (DDQ) (M (SD))	13.2 (8.1)	9.4 (7.0)	-1.5	.14
Total Drinking Consequences (RAPI) (M (SD))	10.0 (5.1)	5.9 (5.0)	-2.4	.02*

Note. *$p < .05$. ✚Fisher's exact test significance value used for comparisons with fewer than five cases in a cell.

Table 7

Responses to the LKM Group Satisfaction and Acceptability Questionnaire (*N* = 15)

Item	% Endorsed (*n*)
Overall, how would you rate your satisfaction with the loving-kindness meditation group?	
Very unsatisfied	0 (0)
Unsatisfied	0 (0)
Somewhat unsatisfied	0 (0)
Somewhat satisfied	13.3 (2)
Satisfied	53.3 (8)
Very satisfied	33.3 (5)
If a friend was experiencing similar difficulties as you, would you recommend this group to them?	
No, definitely not	0 (0)
No, I don't think so	0 (0)
Yes, I think so	86.7 (13)
Yes, definitely	13.3 (2)
Appealing features of group (check all that apply)	
Time of group	60.0 (9)
On-campus location	60.0 (9)
Group length	53.3 (8)
Number of groups	26.7 (4)
Group leaders	66.7 (10)
Group content	53.3 (8)
Group format (versus individual)	53.3 (8)
Homework practice	20.0 (3)
N/A – nothing was appealing	0 (0)
Unappealing features of group (check all that apply)	
Time of group	26.7 (4)
On-campus location	13.3 (2)
Group length	13.3 (2)
Number of groups	0 (0)
Group leaders	0 (0)
Group content	6.7 (1)
Group format (versus individual)	6.7 (1)
Homework practice	13.3 (2)
N/A – nothing was unappealing	20.0 (3)
Which features made it easier to attend group? (check all that apply)	
Time of group	53.3 (8)
On-campus location	60.0 (9)
Email reminders	46.7 (7)
Phone reminders	26.7 (4)
Extra credit for time spent on project	46.7 (7)
N/A – none of these factors made it easier to attend	6.7 (1)
Which features made it difficult to attend group? (check all that apply)	
Location of group was inconvenient	13.3 (2)
Time of group was inconvenient	26.7 (4)
School commitments	0 (0)
Work commitments	20.0 (3)
Transportation issues	0 (0)
Lacked childcare	0 (0)
N/A – none of these factors made it difficult to attend	40.0 (6)

Table 8

Baseline Characteristics by LKM Completer Status

	LKM completer (*n*=20)	**LKM non-completer (*n*=16)**		
	%	**%**	**$\chi 2$ / *t***	***p***
Women	70.0	68.8	.01	.94
Age (M (*SD*))	19.4 (1.6)	18.9 (.81)	-1.3	.22
Sexual orientation				
Straight[+]	95.0	93.8		1.0
Gay[+]	5.0	6.3		1.0
Bisexual	0.0	0.0	--	--
Questioning	0.0	0.0	--	--
Race/ethnicity				
White[+]	80.0	37.5		.02*
Asian/Pacific Islander[+]	15.0	25.0		.68
Mixed race[+]	5.0	25.0		.15
Latino[+]	0.0	6.3		.44
Black[+]	0.0	6.3		.44
Year in School				
1st year	65.0	50.0	.82	.36
2nd year[+]	10.0	43.8		.049*
3rd year[+]	25.0	0.0		.05
4th year[+]	0.0	6.3		.44
Residence				
Fraternity or sorority house	45.0	37.5	.21	.65
Campus residence hall[+]	20.0	37.5		.29
Off-campus apartment or house[+]	35.0	20.0		.72
At home with parents	0.0	0.0	--	--
PTSD Symptoms (PCL-5) (M (SD))	23.4 (13.5)	22.1 (16.2)	-.25	.81
Total Drinks Past Week (DDQ) (M (SD))	9.2 (6.0)	11.1 (6.4)	.91	.37
Total Drinking Consequences (RAPI) (M (SD))	7.3 (4.3)	7.1 (5.7)	-.15	.89

Note. *$p < .05$. [+]Fisher's exact test significance value used comparisons with fewer than five cases in a cell.

Table 9

Baseline Correlations Among Study Variables (*N* = 75)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. PCL-5	____									
2. DDQ	.25*	____								
3. RAPI	.25*	.50***	____							
4. PTCI	.42***	.12	.31*	____						
5. SCS	-.29*	-.17	-.28*	-.60***	____					
6. AAQ-II	.41***	.02	.36**	.71***	-.66***	____				
7. CESD	.27*	.16	.21	.48***	-.39**	.58***	____			
8. DMQ - Social	.13	.52***	.31**	.06	-.11	.09	.00	____		
9. DMQ - Coping	.42***	.34**	.37**	.45***	-.50***	.58***	.27*	.44***	____	
10. DMQ - Enhance	.14	.44***	.22	.16	-.21	.13	.09	.62***	.48***	____
11. DMQ - Conform	.04	.20	.10	.13	.05	.06	.07	.43***	.17	.19

Note. *p <.05, **p <.01, ***p <.001. PCL-5 = PTSD Checklist for DSM-5; DDQ = Daily Drinking Questionnaire; RAPI = Rutgers Alcohol Problem Index; PTCT = Posttraumatic Cognitions Inventory; SCS = Self-Compassion Scale; AAQ-II = Acceptance and Action Questionnaire; CESD = Center for Epidemiologic Studies Depression Scale-Revised; DMQ = Drinking Motives Questionnaire-Revised.

Table 10

Final Multilevel Model Predicting PTSD Symptoms (*N* = 75)

Fixed Effects	**Coefficient**	**S.E.**	**95% CI**
Intercept	9.31	8.88	[-8.43, 27.06]
Time	-1.27	1.31	[-3.90, 1.35]
Condition	-3.07	3.15	[-9.36, 3.21]
Time x Condition	-0.09	0.89	[-1.86, 1.68]
Depression	0.62	0.23	[0.17, 1.08]**
Social drinking motives	-0.24	0.47	[-1.19, 0.71]
Coping drinking motives	1.78	0.40	[0.97, 2.58]***
Enhancement drinking motives	-0.43	0.46	[-1.35, 0.48]
Conformity drinking motives	-0.35	0.46	[-1.26, 0.57]

Random Effects	**Variance**	**S.E.**	**95% CI**
Intercept	115.29	26.70	[62.00, 93.32]***
Time	5.45	2.05	[2.61, 11.39]**

Note. *p <.05, **p <.01, ***p <.001

Table 11

Generalized Estimating Equation Predicting Drinking Quantity Including Interaction (*N* = 75)

Parameter	**Coefficient**	**Rate Ratio**	**S.E.**	**95% CI**
Intercept	0.36	1.43	0.39	[-0.40, 1.12]
Time	-0.07	0.93	0.08	[-0.23, 0.08]
Condition	0.02	0.98	0.14	[-0.26, 0.31]
Time x Condition	-0.03	0.97	.06	[-0.15, 0.09]
Depression	0.00	1.00	0.01	[-0.02, 0.03]
Social drinking motives	0.09	1.09	0.02	[0.04, 0.14]***
Coping drinking motives	0.00	1.00	0.02	[-0.03, 0.03]
Enhancement drinking motives	0.02	1.02	0.01	[-0.01, 0.05]
Conformity drinking motives	-0.01	0.99	0.02	[-0.05, 0.03]

Note. *p <.05, **p <.01, ***p <.001

Table 12

Final Trimmed Generalized Estimating Equation Predicting Drinking Quantity (*N* = 75)

Parameter	**Coefficient**	**Rate Ratio**	**S.E.**	**95% CI**
Intercept	0.41	1.51	0.39	[-0.36, 1.18]
Time	-0.11	0.90	0.03	[-0.17, -0.06]***
Condition	-0.02	0.98	0.12	[-0.27, 0.22]
Depression	0.00	1.00	0.01	[-0.02, 0.03]
Social drinking motives	0.09	1.09	0.02	[0.04, 0.14]***
Coping drinking motives	0.00	1.00	0.02	[-0.03, 0.03]
Enhancement drinking motives	0.02	1.02	0.01	[-0.01, 0.05]
Conformity drinking motives	-0.01	0.99	0.02	[-0.05, 0.03]

Note. *p <.05, **p <.01, ***p <.001

Table 13

Generalized Estimating Equation Predicting Negative Drinking Consequences with Interaction (*N* = 75)

Parameter	**Coefficient**	**Rate Ratio**	**S.E.**	**95% CI**
Intercept	0.11	1.12	0.46	[-0.79, 1.0]
Time	-0.27	0.76	0.35	[-0.95, 0.40]
Condition	0.21	1.24	0.19	[-0.17, 0.59]
Time x Condition	-0.02	0.98	0.19	[-0.40, 0.35]
Depression	-0.01	0.99	0.01	[-.04, 0.01]
Social drinking motives	0.04	1.04	0.03	[-0.01, 0.10]
Coping drinking motives	0.08	1.08	0.02	[0.04, 0.12]***
Enhancement drinking motives	-0.01	0.99	0.03	[-0.07, 0.04]
Conformity drinking motives	0.00	1.00	0.02	[-0.04, 0.05]

Note. *p <.05, **p <.01, ***p <.001

Table 14

Final Trimmed Generalized Estimating Equation Predicting Negative Drinking Consequences (*N* = 75)

Parameter	**Coefficient**	**Rate Ratio**	**S.E.**	**95% CI**
Intercept	0.12	1.13	0.40	[-0.67, 0.91]
Time	-0.30	0.74	0.09	[-0.49, -0.12]**
Condition	0.20	1.22	0.15	[-0.10, 0.50]
Depression	-0.01	0.99	0.01	[-.04, 0.01]
Social drinking motives	0.04	1.04	0.03	[-0.01, 0.10]
Coping drinking motives	0.08	1.08	0.02	[0.04, 0.12]***
Enhancement drinking motives	-0.02	0.98	0.03	[-0.07, 0.04]
Conformity drinking motives	0.00	1.00	0.02	[-0.04, 0.05]

Note. *p <.05, **p <.01, ***p <.001

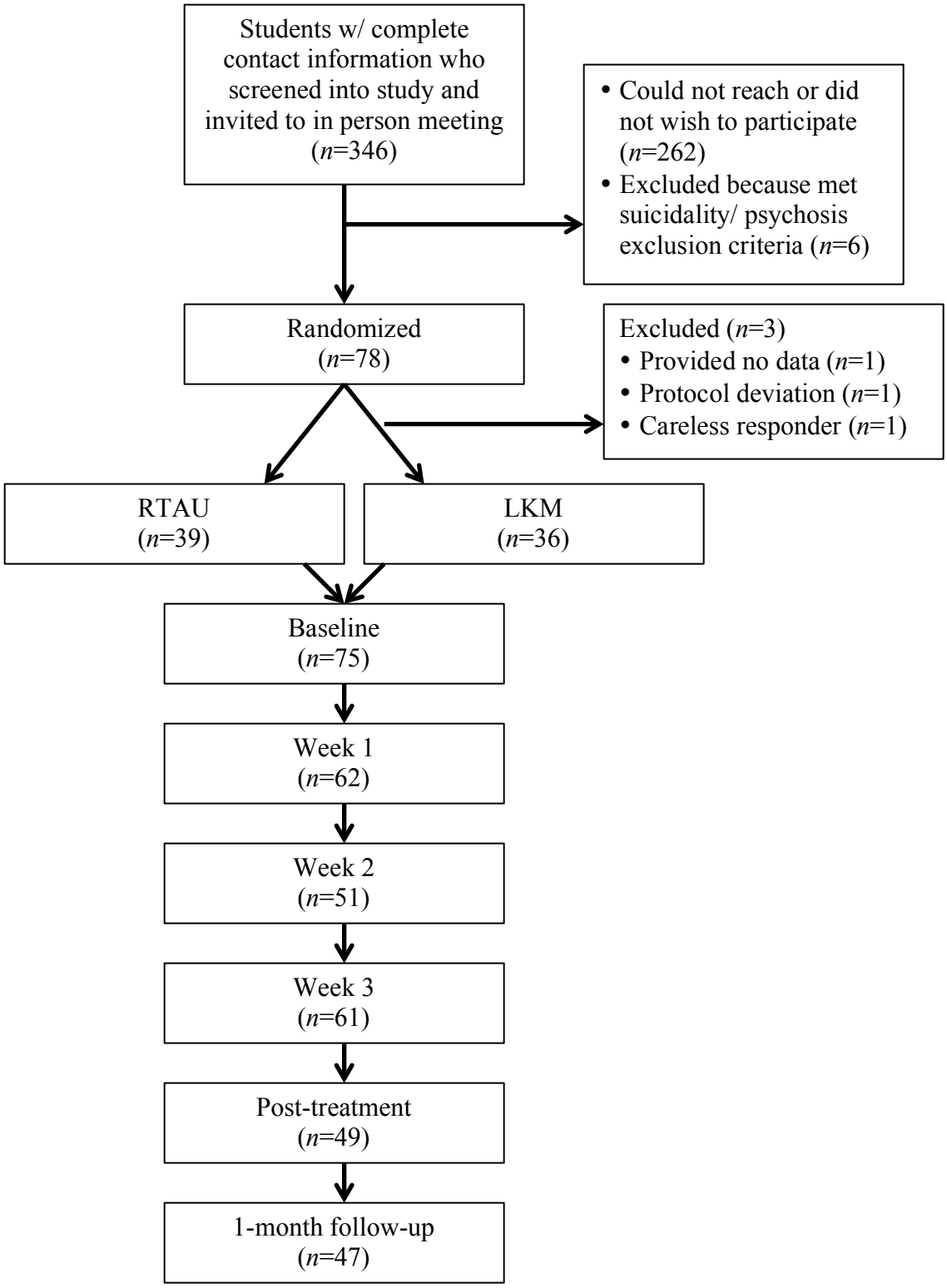

Figure 1. Study flow diagram

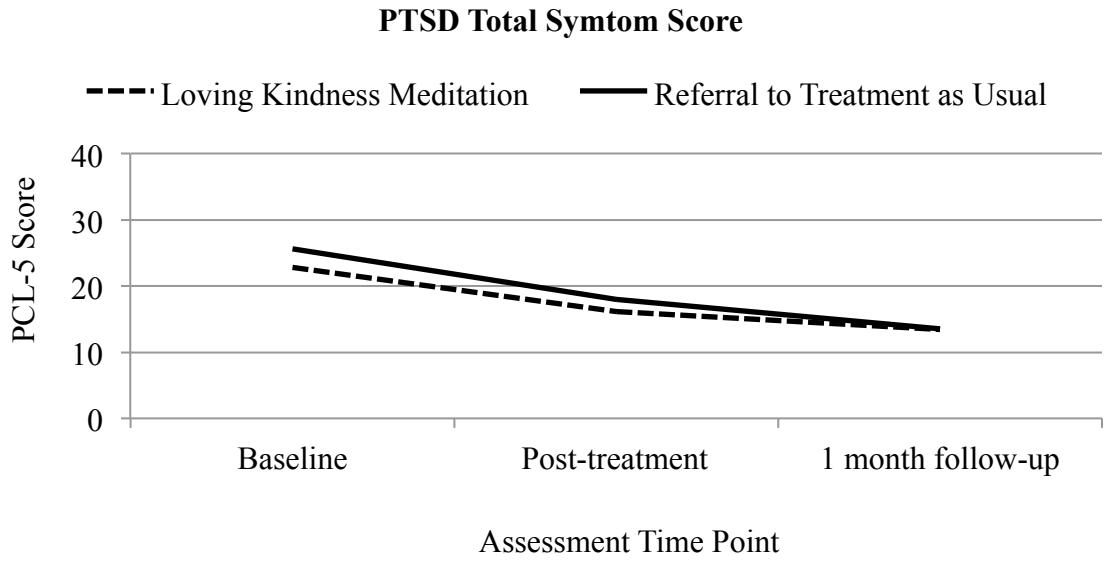

Figure 2. Changes in observed total PTSD symptoms over time by condition

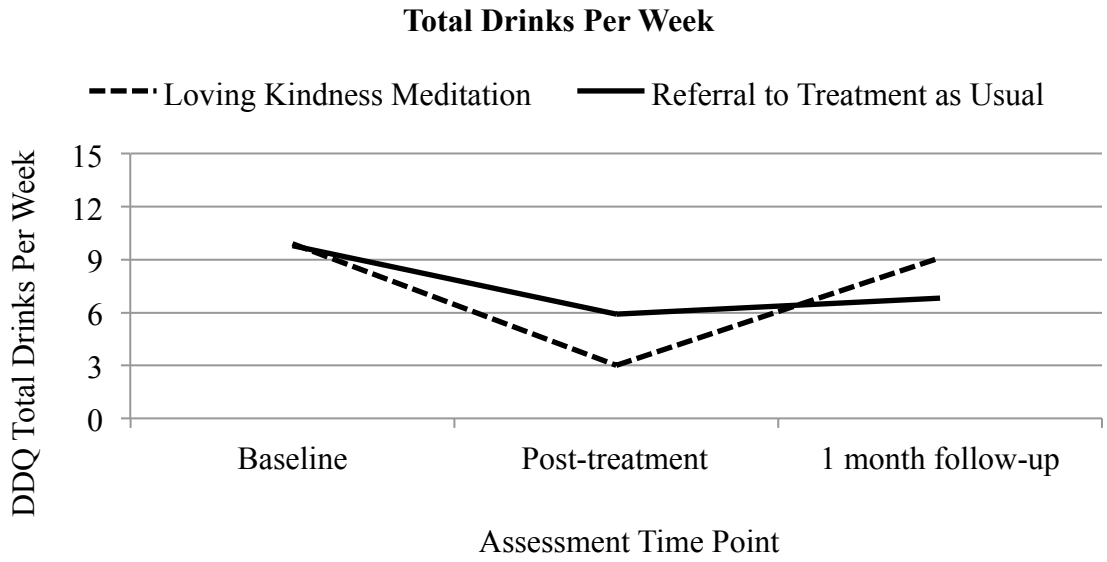

Figure 3. Changes in observed drinking quantity over time by condition

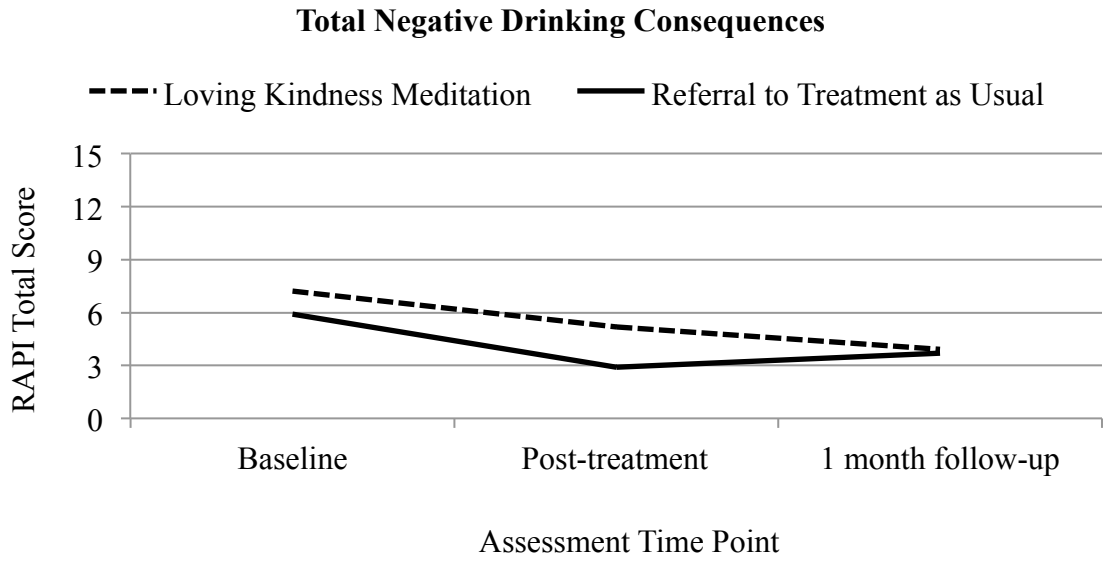

Figure 4. Changes in observed negative drinking consequences over time by condition