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Abstract

Mindfulness-based strategies show promise for targeting the construct of impulsivity and associated variables among problematic alcohol users. This study examined the moderating role of intervention (mindfulness vs relaxation vs control) on trait impulsivity and three outcomes examined post-intervention (negative affect, positive affect, and urge to drink) among 207 college students with levels of at-risk drinking. Moderation analyses revealed that for participants who underwent the mindfulness intervention (compared to relaxation), higher levels of certain facets of impulsivity were associated with increased negative affect and urge, and decreased positive affect post-mindfulness intervention. Examination of simple slopes revealed that for participants with low levels of negative urgency, the mindfulness intervention resulted in a low urge. However, for participants with high levels negative urgency the mindfulness intervention was associated with high urge. For participants with low levels of negative and positive urgency, the relaxation intervention was associated with high levels of urge and low positive affect, respectively. On the other hand, those with high negative and positive urgency reported low levels of urge and high positive affect, respectively. Findings suggest that level (low vs high) and subscale of impulsivity matter with regard to how a participant will respond to a mindfulness versus relaxation intervention.

Keywords: impulsivity; mindfulness; alcohol; affect; college students

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1. Introduction

Among college students, 39% report binge drinking (five or more alcoholic drinks on one occasion) and 12.7% indicate heavy drinking (five or more drinks on one occasion on five days or more over the past month; SAMSHA, 2014). College students engage in more problematic drinking behaviors than their non-college aged peers (SAMSHA, 2014; Wechsler et al., 2002), and several negative consequences have been associated with problematic drinking among college students such as impaired driving, interpersonal violence, academic impairment, and suicidal ideation and attempts (Perkins, 2002). Previous research has indicated that traits, including impulsivity, may impact problematic drinking among this population (Labrie, Kenney, Napper, & Miller, 2014).

Impulsivity is considered a multi-faceted construct and has been defined according to five subscales – (1) Negative Urgency (an individual's likelihood of acting impulsively when experiencing negative affect), (2) Lack of Premeditation (not thinking about the consequences of an action before engaging in that act), (3) Lack of Perseverance (lacking the tendency to focus on a boring or difficult task), (4) Sensation Seeking (engagement in activities that are exciting and that may or may not be dangerous), and (5) Positive Urgency (an individual's likelihood of acting impulsively when experiencing positive affect; Cyders & Smith 2007; Whiteside & Lyman, 2001). These facets of impulsivity have demonstrated differential relationships with alcohol-use outcomes. For instance, among college students, Sensation Seeking is related to increased frequency of alcohol use (Cyders et al., 2009; Labrie et al., 2013), Positive and Negative Urgency has been linked to increased quantity of alcohol use (Cyders et al., 2009;

Labrie et al., 2013), and Positive Urgency alone has been associated with negative consequences from drinking (Cyders, Flory, Rainer, & Smith, 2009). Furthermore, individuals with high levels of impulsivity endorse increased urge to drink in laboratory settings (impulsivity in these studies was determined via performance on behavioral tasks; MacKillop et al., 2010; Papachristou, Nederkoorn, Corstjens, & Jansen, 2012).

Impulsivity is also related to certain mood states, including increased negative affect/depression in the general population (Corruble et al., 2003; Cyders & Coskunpinar, 2011) and among college students (Emmons & Diener, 1986; Langhinrichsen-Rohling et al., 2004). One of these studies actually found that the relationship between depressive symptoms and alcohol use was moderated by impulsivity (specifically Negative Urgency and Sensation Seeking), such that as impulsivity increased, the relationship between depressive symptoms and alcohol use strengthened (Cyders & Coskunpinar, 2011). The association of positive affect and impulsivity, on the other hand, is more complicated. Some research has found that positive affect is a protective factor, and is linked to increased self-control among college students (Isen & Reeve, 2005; Ramezani & Gholtash, 2015). However, when looking at the impact of positive affect on specific impulsive behaviors related to alcohol use, positive affect has been associated with increased alcohol use and the experience of negative consequences related to drinking among college students (Del Boca, Darkes, Greenbaum, & Goldman, 2004).

1.1 Impulsivity as Related to Emotion and Attention

The ability to control attention and manage emotions (e.g., the inhibition of emotional reactions that are related to impulsive behaviors) may be potential mechanisms through which impulsivity is attenuated (Ainslie & Haslam, 1992). These two constructs can be viewed as overlapping, as they usually occur simultaneously (Ainslie & Haslam, 1992). As such, having

the ability to attend to a boring or challenging task should result in increased perseverance (as captured by the Lack of Perseverance facet) and acting mindfully when experiencing certain mood states, as opposed to rashly, should result in the management of certain moods (as captured by the Negative and Positive Urgency facets; Cyders et al., 2007; Whiteside & Lynam, 2001). Together, these constructs suggest that managing emotion and attention are central aspects of impulsivity. Below we describe how mindfulness is also associated with both the management of emotions and control of attention, and how mindfulness could function to attenuate impulsivity.

1.2 Mindfulness and Substance Use

Mindfulness has been defined as, "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 1994, p. 4). Increases in state mindfulness, defined as one's ability to be mindful in a given moment (Lau et al., 2006), has been linked to increases in trait mindfulness, defined as one's natural tendency to be mindful (Baer et al., 2006a; Kiken et al., 2015). While trait mindfulness captures an individual's general tendency to be mindful (Baer et al., 2006a), mindfulness-based interventions often aim to change some behavior through increasing mindfulness (usually measured through changes in state and/or trait mindfulness). These interventions typically consist of about 8 group treatment sessions, with a specific topic for each session (e.g., awareness of triggers, how to be mindful in daily life and in high-risk situations, approaching thoughts from a decentered perspective). Participants are guided through formal meditation each session, and for homework are asked to practice meditating at home, along with incorporating the skills learned in each session into their day-to-day life (Bowen, Chawla, & Marlatt, 2010).

Mindfulness-based interventions to treat problematic substance use behaviors have been well-supported, as results have indicated decreases in craving (Chen et al., 2010; Chiesa &

Serretti, 2014; Garland, Manusov, Froeliger, Kelly, Williams, & Howard, 2014), substance use behavior (Bowen et al., 2006; Bowen et al., 2014; Brewer et al., 2011; Chiesa & Serretti, 2014; Witkiewitz et al., 2014), and substance-related consequences (Bowen et al., 2006; Witkiewitz et al., 2014) post-treatment. While fewer studies have examined brief, laboratory-based mindfulness interventions, Bowen and Marlatt (2009) demonstrated that a brief, 11-minute, intervention decreased smoking behavior in college student cigarette smokers.

1.3 Mindfulness as Related to Emotion and Attention

Trait mindfulness is linked to both the regulation of emotion/affect and the control of attention that are hypothesized to be associated with impulsivity (discussed in more detail below). A recent theoretical model has proposed that mindfulness improves attention through two related processes – increased awareness of affect and acceptance of experiences (Teper et al., 2013).

Mindfulness practices are rooted in taking a nonjudgmental stance towards difficult experiences (e.g., unpleasant affect, negative thoughts; Kabat-Zinn, 1994) and have been found to decrease levels of negative affect (Arch & Craske, 2006; Jain et al., 2007; Ortner et al., 2007; Tang et al., 2007; Vinci et al., 2014) and increase positive affect (Davidson et al., 2003; Jain et al., 2007; Tang et al., 2007). Even a very brief, 15-minute mindfulness-based breathing induction assisted individuals in managing negative affect when compared to two control groups (Arch & Craske, 2006). Performance on attentional tasks has improved following mindfulness interventions (e.g., Black et al., 2011; Ortner et al., 2007; Slagter et al., 2007; Tang et al., 2007). For example, Ortner et al. (2007) found that college students who received a 7-week course in mindfulness meditation demonstrated decreases in interference (on a cognitive task) when presented with affective images, as opposed to those in the relaxation group. The authors

concluded that the ability to disengage from the emotional content allowed participants to perform better on the cognitive interference task, and thus potentially increase attention control.

1.4 Direct Relationship between Impulsivity and Mindfulness

While previous work indicates that impulsivity and mindfulness may function through both emotion regulation and attentional control, research attempting to extrapolate the relationship between mindfulness and impulsivity has only recently been directly examined. Both the constructs of mindfulness and impulsivity share an emphasis on present moment focus. However, the decisions and subsequent consequences following engagement in mindful versus impulsive processes vary greatly (Murphy & MacKillop, 2011). Research has shown that mindfulness and impulsivity are generally inversely correlated; individuals reporting increased mindfulness are less impulsive and vice versa (Murphy & MacKillop, 2011; Peters et al., 2011).

Murphy and MacKillop (2011) examined the relationship between mindfulness (measured by the Five Factor Mindfulness Questionnaire [FFMQ]) and impulsivity (measured by the Urgency-Premeditation-Perseverance-Sensation Seeking-Positive [UPPS-P] Impulsivity Scale) in a sample of college student drinkers, in order to better understand the relationship between the multi-faceted constructs of both mindfulness and impulsivity in this sample. The strongest associations were found between Positive and Negative Urgency and mindfulness, such that Positive and Negative Urgency were negatively correlated with the mindfulness facets of Acting with Awareness, Nonreactivity, and Nonjudgment (a smaller effect was found between these impulsivity facets and Describe). These associations suggest that individuals who act impulsively in response to negative and positive affect are not only less aware of their inner experiences, but they are also less likely to evaluate thoughts and emotions. Lack of Premeditation was moderately, negatively correlated with Describe and Nonreactivity, indicating

that those who do not think through the consequences of a decision are less likely to be aware of inner experiences and therefore engage in behaviors more automatically. Sensation Seeking was positively correlated with Observing, suggesting that those who engage in novel activities are also more likely to be aware of the sensations occurring during these activities. Finally, Lack of Perseverance had strong negative associations with Describe and Acting with Awareness (in addition to weaker correlations with Nonjudging and Nonreactivity), indicating that individuals who are unable to persevere through boring or difficult tasks are less likely to fully engage in the task at hand.

Similar results were found by Peters et al. (2011), who examined these same constructs among college students while also controlling for negative affect and general distress. The strongest associations (all negative) were found for Negative Urgency and both Acting with Awareness and Nonjudging, in addition to Lack of Perseverance and Acting with Awareness. Given this study controlled for negative affect and distress, these significant relationships suggests that affect does not completely account for the relationship between mindfulness and impulsivity, but instead demonstrates an important consideration for future research (Peters et al., 2011). It is possible that other factors may account for the mindfulness/impulsivity relationship. For example, "reactivity" is associated with certain aspects of impulsivity (e.g., positive and negative urgency), whereas "nonreactivity" is a facet of mindfulness. Thus, for impulsive versus mindful individuals, reactivity level may be implicated in one's attentional ability and emotional experience.

1.5 Impulsivity and Mindfulness as Related to Substance Use

Consistent with previous literature, Murphy and MacKillop (2011) also discovered that both alcohol use and problematic alcohol use were positively associated with facets of

impulsivity. Furthermore, individuals endorsing problematic alcohol use were less likely to endorse certain facets of mindfulness (specifically Acting with Awareness, Nonreactivity, and Nonjudgment), indicating that they do not engage in these mindfulness practices. The authors postulate that while mindfulness and impulsivity are similar in some aspects regarding their relationships to alcohol use (i.e., negative associations exist with both regarding problematic alcohol use), they are still distinct constructs when examined individually.

1.6 The Current Study

Prior research examining the role of mindfulness on impulsivity and alcohol use through self-report measures has been promising, as mindfulness appears to be related to constructs relevant to both impulsivity and alcohol use (i.e., positive and negative affect), which may be particularly relevant to college student drinkers (given the association between impulsivity and problematic drinking in this population). Based on prior research, a logical next step would be to determine whether among at-risk college student drinkers, trait impulsivity would impact how an individual responds to a mindfulness intervention (when compared to a relaxation and control group).

Thus, the present study attempted to determine whether receiving a particular type of brief intervention (mindfulness, relaxation, or control) would moderate the relationship between baseline level of trait impulsivity (each subscale of the UPPS-P was examined individually) and response to the intervention in a sample of at-risk college student drinkers. Specific outcome variables of interest included positive affect, negative affect, and urge to drink, which were measured pre- and post-intervention. We first hypothesized that the mindfulness group would significantly moderate the relationship between impulsivity and the outcome measures, such that those in the mindfulness group would have decreased negative affect and urge and increased

positive affect, when compared to those in the relaxation and control groups. Second, given the lack of research in this area, we were unsure exactly how level of impulsivity (e.g., low vs high) would impact negative affect, positive affect, and urge to drink for those in the mindfulness group. As such, understanding the role of mindfulness interventions, when directly matched to other comparison interventions, on impulsivity and associated variables among college students will provide important information on how to best intervene with this population.

2. Method

2.1 Participants

Data presented in the current paper were collected from a larger study (n = 207) examining the impact of a mood induction procedure following a brief mindfulness intervention on affect and urge to drink in at-risk college student drinkers (data from all 207 participants are used in the current analyses; see Vinci et al., 2014 for details of full study). The primary outcome study presented findings on the differential effects of each intervention type on the stated outcomes following a mood induction procedure, and did not examine how trait impulsivity interacted with intervention type.

Participants were screened for at-risk drinking via a secure, online system and then invited to attend the experimental portion of the study if eligible. Eligibility criteria included having a score of six or greater on the Alcohol Use Disorders Identification Test (AUDIT; a score of 6-8 indicates hazardous drinking in college students; Adewuya, 2005; Aertgeerts et al., 2000; Devos-Comby & Lange, 2008; Kokotailo et al., 2004; Meneses-Gaya et al., 2009) and being elevated on at least one of two subscales of the Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). Specifically, participants needed to be elevated on either the Coping or Enhancement motive (or both) on the DMQ-R to be eligible, in order to recruit those individuals

who endorse drinking as a way to cope with emotions (a goal for the larger study). Eligible participants attended the experimental portion of the study one to two weeks following screening.

2.2 Self-Report Measures

2.2.1 Demographic Questionnaire. Participants completed a demographic questionnaire developed by the experimenters assessing areas such as age, race, and gender.

2.2.2 Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001). The AUDIT is a 10-item self-report measure that assesses hazardous alcohol use on a 0-4 Likert scale. Research examining the AUDIT has found that among college students, a cut-off score of six and above best identifies hazardous drinking when examining sensitivity and specificity outcomes (Adewuya, 2005; Aertgeerts et al., 2000; Devos-Comby & Lange, 2008; Kokotailo et al., 2004; Meneses-Gaya et al., 2009); thus, this cut-off was used in the present study to recruit at-risk drinkers. Internal consistency for the present study was adequate (r = .64)

2.2.3 Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). The DMQ-R is 20-item self-report measure used to assess four drinking motives: Enhancement, Coping, Social Affiliative, and Social Conformity. The present study included only those participants primarily endorsing drinking for enhancement or coping motives, given these motives reflect those individuals who drink to manage mood. Specifically, out of the four subscales, participants had to have the highest scores on either the Enhancement or Coping subscales. Internal consistency results for each subscale were as follows: Enhancement: (r = .84), Coping (r = .83, Social Affiliative (r = .62), and Social Conformity (r = .84)

2.2.4 The Five-Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006b). The FFMQ is a 39-item measure assessing five facets of dispositional mindfulness on a 5-point Likert scale.

This questionnaire was developed through factor analysis of previous mindfulness rating scales assessing mindfulness. Five factors emerged and constitute the FFMQ: Observing, Describing, Acting with Awareness, Nonjudging, and Nonreactivity. The current study resulted in the following internal consistency results: Observing (r = .70), Describing (r = .91), Acting with Awareness (r = .87), Nonjudging (r = .87), and Nonreactivity (r = .71). In the current study, this measure was used to assess participants' general degree of trait mindfulness pre-intervention (i.e., their general level of mindfulness in their daily lives).

2.2.5 Urgency-Premeditation-Perseverance-Sensation Seeking-Positive Impulsivity Scale (UPPS – P; Cyders & Smith 2007; Cyders et al., 2007; Whiteside & Lynam, 2001). The UPPS – P is a 59-item self-report measure of impulsivity, with each question being rated on a 4-point Likert scale. The UPPS – P was developed based on the Five Factor Model of personality, with questions being combined from several other measures of impulsivity. The five subscales of the UPPS-P include: Negative Urgency, Premeditation, Perseverance, Sensation Seeking, and Positive Urgency. Many items on the measure are reversed scored and elevations on any subscale indicate higher levels of impulsivity. The current study yielded internal reliability estimates for the following subscales: Negative Urgency (r = .87), Premeditation (r = .85), Perseverance (r = .84), Sensation Seeking (r = .86), and Positive Urgency (r = .94). The UPPS – P was used in the present study to examine participants' general degree of impulsivity pre-intervention.

2.2.6 Toronto Mindfulness Scale (TMS; Lau et al., 2006). The TMS is a 12-item self-report measure of state mindfulness. Participants respond to each item using a 5-point Likert scale. The TMS has two subscales: Curiosity (approaching the present moment with a sense of curiosity) and Decentering (observing feelings and thoughts, while keeping distance from them).

Previous research on this measure has indicated that the TMS has good internal consistency (r = .95) and post-treatment predictive validity regarding stress and psychological symptoms (Lau et al., 2006). In the present study, the Curiosity subscale demonstrated an internal consistency of .85 and the Decentering subscale .65. This measure was used in the present analyses to determine state mindfulness pre- and post-intervention. Thus, while the FFMQ assesses participants' general degree of mindfulness, the TMS allows for changes in mindfulness to be examined from moment-to-moment, and therefore represents a theoretically different measure of mindfulness. Specifically, the TMS asks participants about "what they just experienced," whereas the FFMQ asks participants about how mindful they are in their day-to-day lives (and not specifically about the previous moment).

2.2.7 Positive and Negative Affective Schedule (PANAS; Watson et al., 1988). The PANAS is a 20-item self-report measure that assesses an individual's negative and positive affect at a given point in time (for the current study, participants were asked to respond to questions according to how they feel "right now, at the present moment"). Twenty different emotions are listed, and individuals rate items on a 5-point Likert scale (possible range of responses: 10 – 50 for each subscale). The current study yielded the following internal consistency estimates – positive affect: r = .84; negative affect: r = .70. The present study utilized the PANAS to examine negative and positive affect at pre- and post-intervention.

2.2.8 Urge to Drink. Participants' urge to drink was assessed via a 10-point Likert scale, stating "Please rate your urge to drink at this moment by circling a number on the scale below." Participants indicated their response from 1 (absolutely no urge) to 10 (very strong urge). Single-item measures have been found to be both reliable and valid in assessing urge to drink (Monti et al., 2000). Urge to drink was assessed at both pre- and post-intervention.

2.3 Brief Interventions

2.3.1 Mindfulness intervention. Participants in the mindfulness intervention underwent a 10-minute guided meditation (listened to on a cassette tape) instructing them to focus on the present moment, while noting their breath and any other physical sensations that may be occurring (e.g., touch, taste, sound). They were asked to do this with an attitude of acceptance and nonjudgment. A tape recording utilized by Adams et al. (2013) was used in the present study (for a written transcript of these instructions, please see Vinci et al., 2014). Results from both Adams et al. (2013) and Vinci et al. (2014) demonstrated that participants who were guided through the mindfulness meditation significantly increased in state levels of mindfulness when compared to the groups that did not listen to the tape. This mindfulness meditation was primarily adapted of selections from Kabat-Zinn (1994, 2002); the five facets of mindfulness (Baer et al., 2006a) were also integrated throughout the recording.

2.3.2 Relaxation intervention. Participants in this group underwent a guided, 10-minute relaxation intervention (also listened to on cassette tape), which was based on passive, progressive muscle relaxation (Feldman et al., 2010). This active comparison intervention was chosen in order to determine if the mindfulness intervention provided skills above and beyond just increased relaxation. See Vinci et al. (2014) for both more detail regarding this intervention and a written transcript of the instructions provided to participants.

2.3.3 Control intervention. Participants in the control group completed a word search puzzle for 10 minutes. This intervention was chosen to control for the passage of time and to have participants engaged in a focused task (as opposed to allowing their minds to wander).

2.4 Procedure

All study procedures were approved by the university's Institutional Review Board. College student drinkers were recruited for the study through the psychology department's experiment website and provided course credit for participating. Participants were also recruited via flyers on the campus; these individuals did not receive any incentive for participating. Data for the screening phase was collected and stored through a secure online survey engine. Participants signed up for the study and indicated their consent to participate. They then completed the following questionnaires to determine eligibility: demographic form, the AUDIT, and the DMQ-R. Participants interested in the second phase of the study were asked to provide their email address in order to be contacted for scheduling if they were eligible (given most participants completed the study for course credit, some expressed disinterest due to already receiving all of their credit points). Eligible participants were then contacted and those interested in participating were scheduled within one to two weeks to complete the experimental portion of the study.

The second phase was conducted between 3:00pm and 8:00pm Monday through Friday. Sessions were conducted individually (and not in groups) for all participants. Participants completed the FFMQ and UPPS – P upon arrival. Participants were randomly assigned to groups and then completed baseline measures of the PANAS, TMS, and single-item urge question. They then underwent their respective intervention, followed by immediately completing the PANAS, TMS, and single-item urge question post-intervention. The approximate amount of time that lapsed from the completion of the baseline measures to the completion of the post-intervention measures was 15-20 minutes. The remainder of the study is not presented here, as it is not relevant to the primary hypotheses (Vinci et al., 2014).

3. Results

A total of 1,831 participants completed the initial screening phase, and 394 were eligible for the experimental portion of the study. Though all 394 participants were invited to attend, 207 chose to do so (96.1% participated for course credit). Sixty-seven participants completed the mindfulness intervention, 74 were in the relaxation group, and 66 in the control group. The average age of the sample was 20.13 (SD = 1.89) and consisted of 76.3% women. Participants identified as 85.5% Caucasian, 6.3% African American, and 8.3% Other.

Participants had an average score of 10.03 (SD = 4.28) on the AUDIT (indicating that participants were engaging in levels of hazardous drinking; Babor et al., 2001). Intervention groups did not differ on age, AUDIT score, FFMQ subscales, UPPS – P subscales, or any of the outcome variables at baseline. Chi square analyses revealed no significant differences between the proportions of males and females in the intervention groups. Following the interventions, the following means and standard deviations were found for the outcome variables of interest: Negative Affect (M = 12, SD = 3.08), Positive Affect (M = 24.48, SD = 7.56), Urge (M = 2.42, SD = 1.87).

3.1 Initial Bivariate Correlations

Given our interest in further understanding the relationship between impulsivity and mindfulness among at-risk drinkers, correlational analyses for the entire sample on UPPS – P subscales, FFMQ subscales, TMS (at baseline) scores, and AUDIT scores were conducted (see Table 1). Associations were in the expected directions for several variables. Exceptions to this included: state mindfulness was positively associated with Sensation Seeking and Positive Urgency; Sensation Seeking was positively associated with the trait mindfulness subscales of Observe and Nonreactivity; and state mindfulness was negatively associated with the trait mindfulness subscales of Acting with Awareness and Nonjudging.

3.2 Primary Analyses

As this is a secondary data analysis, it is important to note that the primary outcome study did find that immediately following the interventions, participants in the mindfulness group decreased significantly in negative affect (when compared to the control group), participants in the relaxation group decreased in positive affect (when compared to the mindfulness and control groups), and that there were no significant changes in urge (Vinci et al., 2014). Additionally, the mindfulness group reported significant increases in state mindfulness from pre- to post-mindfulness intervention, and were also higher in state mindfulness than both the relaxation and control groups post-intervention (Vinci et al., 2014), indicating that the mindfulness intervention was effective at increasing state mindfulness.

To examine our hypothesis that intervention type (specifically the mindfulness group) would moderate the relationship between baseline trait impulsivity (Negative Urgency, Premeditation, Perseverance, Sensation Seeking, and Positive Urgency) and our outcome variables (Negative Affect, Positive Affect, and Urge), a series of hierarchical multiple regression analyses were conducted. Covariates were entered into Step 1 and included the baseline measurement of the outcome variable (e.g., baseline negative affect was entered when predicting negative affect post-intervention to control for the baseline value), gender (as previous research has indicated that college student males drink more alcohol than college student females; Berkowitz & Perkins, 1986; Nolen-Hoeksema, 2004; O'Malley & Johnston, 2002), and total AUDIT score (to control for level of problematic drinking). Step 2 included the main effects of group and impulsivity subscale score. Step 3 included the product of group and impulsivity subscale score. For this interaction term, the mindfulness group was coded as the reference group.

Results from the hierarchical multiple regression analyses indicated that intervention type significantly moderated the relationship in four models (see Table 2 for results these models). First, the relaxation group (when compared to the mindfulness group) moderated the relationship between Sensation Seeking and Negative Affect [$F(8,198) = 10.15$, $p = .001$]. Specifically, for every one point increase on Sensation Seeking, participants in the relaxation group decreased 1.54 points in Negative Affect, when compared to those in the mindfulness group. To probe the interaction, examination of the simple slopes was conducted and revealed that neither slope was significant from zero (mindfulness: $b = .36$, $p = .52$; relaxation: $b = -1.18$, $p = .34$). Thus, while the effect of sensation seeking was significantly different for participants in the mindfulness versus relaxation groups regarding their ratings of negative affect, the degree to which sensation seeking matters within each group was not significant.

Second, the relaxation group (when compared to the mindfulness group) moderated the relationship between Negative Urgency and Urge [$F(8,195) = 93.48$, $p = .001$]. Specifically, for every one point increase on Negative Urgency, participants in the relaxation group decreased .82 points in Urge, when compared to the mindfulness group. Examination of the simple slopes revealed a significant association between Negative Urgency and Urge for participants in both the mindfulness and relaxation groups. For participants in the mindfulness group, having low trait Negative Urgency was associated with low reports of Negative Affect, whereas participants with high trait Negative Urgency reported high Negative Affect ($b = .4$, $t = 2$, $p = .046$). The opposite pattern was observed for participants in the relaxation group, such that for those with low trait Negative Urgency, Negative Affect was high; for those with high trait Negative Urgency, Negative Affect was low ($b = -.42$, $t = -2.1$, $p = .037$). See Figure 2.

Third, the relaxation group (when compared to the mindfulness group) moderated the relationship between Positive Urgency and Positive Affect [F(8,198) = 24.26, p = .001]. Specifically, for every one point increase on Positive Urgency, participants in the relaxation group increased 3.74 points in Positive Affect, when compared to the mindfulness group. Examination of the simple slopes revealed a significant effect for the relaxation group, such that for participants low in trait Positive Urgency, Positive Affect was low; for participants with high trait Positive Urgency, Positive Affect was high (b = 2.95, t = 2.68, p = .007). See Figure 3.

Fourth, the control group (when compared to the mindfulness group) moderated the relationship between Perseverance and Positive Affect [F(8,198) = 23.29, p = .001]. Specifically, for every one point increase on Perseverance, participants in the control group decreased 3.78 points in Positive Affect, when compared to the mindfulness group. Examination of the simple slopes revealed no significant findings (mindfulness: b = 1.67, p = .200; relaxation: -2.11, p = .132).

4. Discussion

The current study examined the moderating role of a brief mindfulness intervention (vs relaxation and control) on the relationship between trait impulsivity and negative affect, positive affect, and urge to drink. First, and somewhat unexpectedly, three of the four significant moderation analyses revealed that for participants who underwent the mindfulness intervention (compared to the relaxation group), higher levels of certain facets of impulsivity were associated with increased negative affect and urge, and decreased positive affect post-mindfulness intervention. Second, results of simple slope analyses revealed that the level of impulsivity interacted with intervention type, such that changes in affect and urge differed depending on whether participants were low versus high on certain subscales of impulsivity.

To expand upon the significant interactions, we found that the relationship between certain subscales of impulsivity (Sensation Seeking, Negative Urgency, and Positive Urgency) and outcome (Negative Affect, Urge, and Positive Affect, respectively) was moderated by type of intervention; in particular, an increase in these facets of trait impulsivity were associated with higher levels of negative affect and urge, and lower levels of positive affect among those receiving mindfulness intervention compared to those receiving relaxation intervention. However, the fourth significant interaction revealed that for those who underwent the mindfulness intervention (when compared to the control group) increases in the impulsivity facet of Perseverance was associated with increased Positive Affect post-mindfulness intervention.

Second, analysis of the simple slopes revealed that for participants with low levels of Negative Urgency, undergoing a mindfulness intervention resulted in a low urge to drink. However, for participants with high levels Negative Urgency the opposite effect was found, such that the mindfulness intervention was associated with high urge to drink. For participants with low levels of Negative and Positive Urgency, the relaxation intervention was associated with high levels of urge to drink and low levels of positive affect, respectively. On the other hand, those with high Negative and Positive Urgency reported low levels of urge and high levels of positive affect, respectively. Overall, these findings suggest that the level (low versus high) and specific type of impulsivity subscale matters with regard to how a participant will respond to a mindfulness versus relaxation intervention.

While previous research has indicated an inverse relationship between the various subscales of impulsivity and trait mindfulness (Murphy & MacKillop, 2011; Peters et al., 2011), this is the first study to examine the relationship between the subscales of impulsivity and response to a mindfulness intervention among problematic alcohol drinkers. Results from the

current study were intriguing, in that the majority of the significant interactions and simple slope analyses revealed that participants with higher trait impulsivity, who underwent the mindfulness intervention, had poor outcomes on negative and positive affect and urge to drink. However, these findings could make sense in light of the strength model of self-regulation (Baumeister, Vohs, & Tice, 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2009; Muraven & Baumeister, 2000). This model posits that individuals have a limited capacity to regulate certain states (e.g., affect, hunger), and when the ability to self-regulate has been depleted, individuals may have difficulty continuing to self-regulate on other tasks. It is possible that undergoing a brief mindfulness intervention might be more depleting than experiencing the relaxation intervention. In fact, a recent study examined the moderating role of group (brief mindfulness intervention versus control group) on pain tolerance (Evans, Eisenlohr-Moul, Button, Baer, & Segerstrom, 2014). Results indicated that for participants in the control group, higher heart rate variability (a measure of self-regulatory capacity) was associated with increased pain tolerance; these findings were not found for participants who underwent the mindfulness condition. The authors posited that such a brief mindfulness intervention may have increased effort and depleted self-regulatory capacity. While the current study did not examine self-regulatory capacity, it is possible that for individuals with high levels of impulsivity, the mindfulness intervention reduced self-regulatory capacity, resulting in the mindfulness intervention being less effective on decreasing negative affect and urge and increasing positive affect than the relaxation intervention. Future research could examine this hypothesis by including a measure of self-regulatory capacity when examining the role of mindfulness on impulsivity.

Given the lack of research on impulsivity and mindfulness among at-risk drinkers, a brief discussion of the bivariate correlations is warranted. Most of the associations were in the

expected directions and consistent with previous findings (Murphy & MacKillop, 2011; Peters et al., 2011). However, positive associations were found between the impulsivity subscales of Sensation Seeking and Negative Urgency and state mindfulness. Prior research on the relationship between mindfulness and various measures of impulsivity, to our knowledge, have only utilized measures of trait mindfulness (Baer et al., 2006a; Lakey et al., 2009; Lattimore et al., 2010; Murphy et al., 2011; Peters et al., 2011; Williams & Grishman, 2012; Wupperman et al., 2009), thus making the current study's findings on the association between the UPPS – P subscales and TMS important. When considering that the TMS measures state levels of mindfulness and the FFMQ examines dispositional mindfulness, it might be the case that the two questionnaires vary considerably when related to impulsivity. Furthermore, the TMS was specifically developed to examine an open curiosity of moment-to-moment, nonjudgmental awareness, such that it notably varies from trait measures (Lau et al., 2006). Future research examining the relationship between state mindfulness and these significant impulsivity subscales should continue to explore any positive associations found. Our results also indicated that associations between the FFMQ and TMS subscales varied, as some were positive and others negative. This finding is less surprising, given the theoretical differences between state and trait mindfulness (i.e., state mindfulness measures momentary shifts in mindfulness, whereas trait mindfulness captures general levels of mindfulness in daily living; Baer et al., 2006b; Lau et al., 2006), as well as evidence that different mindfulness measures are often assessing different constructs (Grossman, 2011; Grossman & Van Dam, 2011).

Clinical implications of these findings suggest that practitioners providing mindfulness and relaxation interventions to at-risk college student drinkers may want to consider their patients' level of impulsivity and subsequent response to these interventions. Monitoring patient

response and assessing level of impulsivity at the outset of therapy would be useful, as individuals with elevations on certain aspects of impulsivity may be more/less likely to experience certain affective states and urges to drink following these two interventions. For example, for individuals reporting low levels of negative urgency, a mindfulness intervention appears to have a positive effect on urge. However, the opposite is true for individuals with high scores on the negative urgency subscale, suggesting that a relaxation intervention may be more appropriate. It is possible that with the increased practice of mindfulness skills, individuals with high negative urgency may benefit in a similar way to those with low negative urgency when undergoing a mindfulness intervention. However, additional research examining these constructs is needed before such recommendations can be made.

Regarding future research in this area, replication of these findings is a necessary first step. Little research has been conducted on how impulsivity is related to mindfulness among at-risk college student drinkers. To our knowledge, no research has examined the role of a brief mindfulness intervention on these constructs, aside from the current study. Research on more extensive interventions (e.g., longer than 10 minutes, multiple sessions) is also suggested, as it is possible that with increased practice, individuals with high impulsivity may respond differently to the mindfulness intervention over time. Consideration of how impulsivity may relate to outcomes following a mindfulness intervention with other populations could be beneficial (e.g., young adults engaging in at-risk drinking who are not in college, individuals seeking treatment for alcohol use problems through an outpatient clinic). For instance, prior work has shown that when only the mindfulness portion of DBT was provided to those with BPD, level of impulsivity decreased (Soler et al., 2012). Other mental health problems that involve impulsivity as a critical mechanism of the disorder may want to explore the differential impact of mindfulness-based

versus relaxation-based interventions, as well as variations in length of intervention on outcomes; such populations may include those with eating disorders (Rosval et al., 2006), anger management problems (Horesh et al., 1997), and suicidality (Horesh et al., 1997).

Limitations of the present study should be noted. First, the sample consisted of at-risk college student drinkers (consisting primarily of women and Caucasians), thus we do not know how these results would generalize to other populations. However, the average AUDIT score of 10.03 indicates that the sample consisted of at-risk alcohol drinkers. Second, the correlations presented in Table 1 should be interpreted with caution, as while they indicate many significant relationships, the strength of these relationships is relatively weak. Third, the present study only examined the immediate change in affect and urge; we do not know whether these changes would maintain over time or if they would vary over time. Fourth, while we utilized a self-report measure to gather level of impulsivity, future studies should incorporate behaviorally-based measures of impulsivity. And fifth, some have argued that many questionnaires assessing mindfulness likely do not accurately capture an individual's level of mindfulness due to inherent difficulties in assessing one's own level of mindfulness, problems with defining mindfulness through questionnaires, and the simplistic nature of questionnaire items (Grossman & Van Dam, 2011; Purser & Milillo, 2014). Additionally, self-report measures often include items that are very similar to the mindfulness instructions, which may not truly represent whether an individual has become more mindful (Grossman & Van Dam, 2011). Future research may want to consider additional assessment methods aside from self-report measures of mindfulness (e.g., interviews).

In conclusion, the current study presents interesting findings on the role of a brief mindfulness intervention on the relationship between aspects of trait impulsivity and negative affect, positive affect, and urge to drink in a sample of at-risk college student drinkers. These

results are applicable to both future research and in clinical settings where brief mindfulness and relaxation exercises are conducted. Nonetheless, future work examining the role of mindfulness on impulsivity, affect, and urge is needed, in order to replicate these findings. Ultimately, determining the effects of lengthier interventions, the impact of such interventions over time, and ways in which to best examine changes in mindfulness and relevant constructs are suggested. While this study warrants such research efforts in problematic drinkers, examining the effects of mindfulness-based interventions in other populations with increased impulsivity, as well as impulsive, non-problematic drinkers are recommended. Lastly, practical considerations of utilizing brief mindfulness and relaxation exercises within a therapeutic context for at-risk drinkers should be considered in light of the findings.

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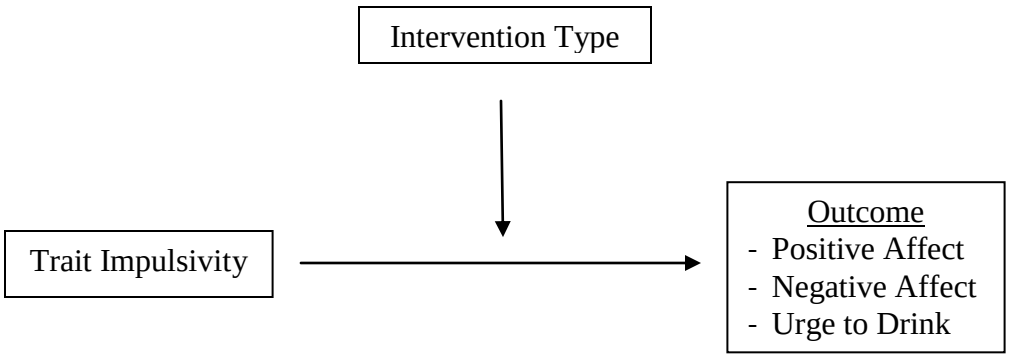

Figure 1. Tested Moderation Model

Table 1. Bivariate correlations of UPPS – P, TMS, FFMQ, and AUDIT scores for entire sample (n = 207) at baseline

	Neg Urg	Premed	Persev	SS	Pos Urg	TMS Cur	TMS Dec	Observe	Describe	AA	Nonjudging	Nonreactivity
Neg Urg	-	-	-	-	-	-	-	-	-	-	-	-
Premed	.40**	-	-	-	-	-	-	-	-	-	-	-
Persev	.31**	.38**	-	-	-	-	-	-	-	-	-	-
SS	.12	.35**	.01	-	-	-	-	-	-	-	-	-
Pos Urg	.57**	.37**	.37**	.31**	-	-	-	-	-	-	-	-
TMS Cur	.16*	-.02	-.03	.14*	.21**	-	-	-	-	-	-	-
TMS Dec	.09	.05	.01	.27**	.22**	.46**	-	-	-	-	-	-
Observe	-.07	-.08	-.03	.19**	.03	.24**	.19**	-	-	-	-	-
Describe	-.24**	-.11	-.17*	-.01	-.18**	.03	.14	.16*	-	-	-	-
AA	-.32**	-.21**	-.41**	-.07	-.34**	-.17	-.21**	-.01	.24**	-	-	-
Nonjudging	-.41**	-.03	-.05	-.07	-.25**	-.22**	-.13	-.12	.13	.21**	-	-
Nonreactivity	-.31**	-.15*	-.13	.18**	-.07	.01	.22**	.19**	.23**	.15*	.07	-
AUDIT	.30	.33**	.30*	.16	.34	.01	.10	.04	-.13	-	-.14*	-.12

	**		*	*	**			.20 **

Note. * = p < .05; ** = p < .01. Neg Urg = UPPS-P Negative Urgency; Premed = UPPS-P Premeditation; Persev = UPPS-P Perseverance; SS = UPPS-P Sensation Seeking; Pos Urg = UPPS-P Positive Urgency; AA = Acting with Awareness; TMS = Toronto Mindfulness Scale; Cur = Curiosity; Dec = Decentering; AUDIT = Alcohol Use Disorders Identification Test

Table 2. Significant Hierarchical Regression Models

Relaxation Group Moderates the Relationship between Sensation Seeking and Negative Affect when Compared to the Mindfulness Group								
	Baseline Negative Affect	Gender	AUDIT	Control Group[a]	Relaxation Group[b]	Sensation Seeking	Sensation Seeking X Control Group[a]	Sensation Seeking X Relaxation Group[b]
B	.34	-.39	.15	1.83	4.28	.36	-.16	-1.54
SE B	.05	.45	.05	2.31	2.26	.56	.77	.76
β	.40***	-.05	.21**	.28	.67	.07	-.08	-.71*
Adjusted R^2				.62				
ΔR^2				.02				
Relaxation Group Moderates the Relationship between Negative Urgency and Urge when Compared to the Mindfulness Group								
	Baseline Urge	Gender	AUDIT	Control Group[a]	Relaxation Group[b]	Negative Urgency	Negative Urgency X Control Group[a]	Negative Urgency X Relaxation Group[b]
B	.77	-.25	.07	.47	1.84	.40	.01	-.82
SE B	.04	.15	.02	.66	.68	.21	.27	.28
β	.81***	-.06	.16***	.12	.47**	.12	.01	-.54**
Adjusted R^2				.79				
ΔR^2				.01**				
Relaxation Group Moderates the Relationship between Positive Urgency and Positive Affect when Compared to the Mindfulness Group								
	Baseline Positive Affect	Gender	AUDIT	Control Group[a]	Relaxation Group[b]	Positive Urgency	Positive Urgency X Control Group[a]	Positive Urgency X Relaxation Group[b]
B	.71	-.42	-.08	2.20	-10.54	-.79	.10	3.74
SE B	.06	.96	.10	3.21	3.19	1.22	1.63	1.63
β	.60***	-.02	-.05	.14	-.67**	-.06	.01	.49*
Adjusted R^2				.48				
ΔR^2				.02*				

Control Group Moderates the Relationship between Perseverance and Positive Affect when Compared to the Mindfulness Group								
	Baseline Positive Affect	Gender	AUDIT	Control Group[a]	Relaxation Group[b]	Persever-ance	Perseverance X Control Group[a]	Perseverance X Relaxation Group[b]
B	.72	-.06	4.03	9.38	-1.32	1.67	-3.78	-1.15
SE B	.06	.92	.10	3.58	3.65	1.30	1.84	1.83
β	.61***	-.01	.01	.58*	-.08	.11	-.46*	-.15
Adjusted R^2				.46				
ΔR^2				.01				

Note: * = p < .05; ** = p < .01, *** = p < .001
[a]dummy coded as: 0 = mindfulness and relaxation groups; 1 = control group
[b]dummy coded as: 0 = mindfulness and control groups; 1 = relaxation group
AUDIT = Alcohol Use Disorders Identification Test
B = unstandardized coefficient; SE = standard error; β = standardized coefficient

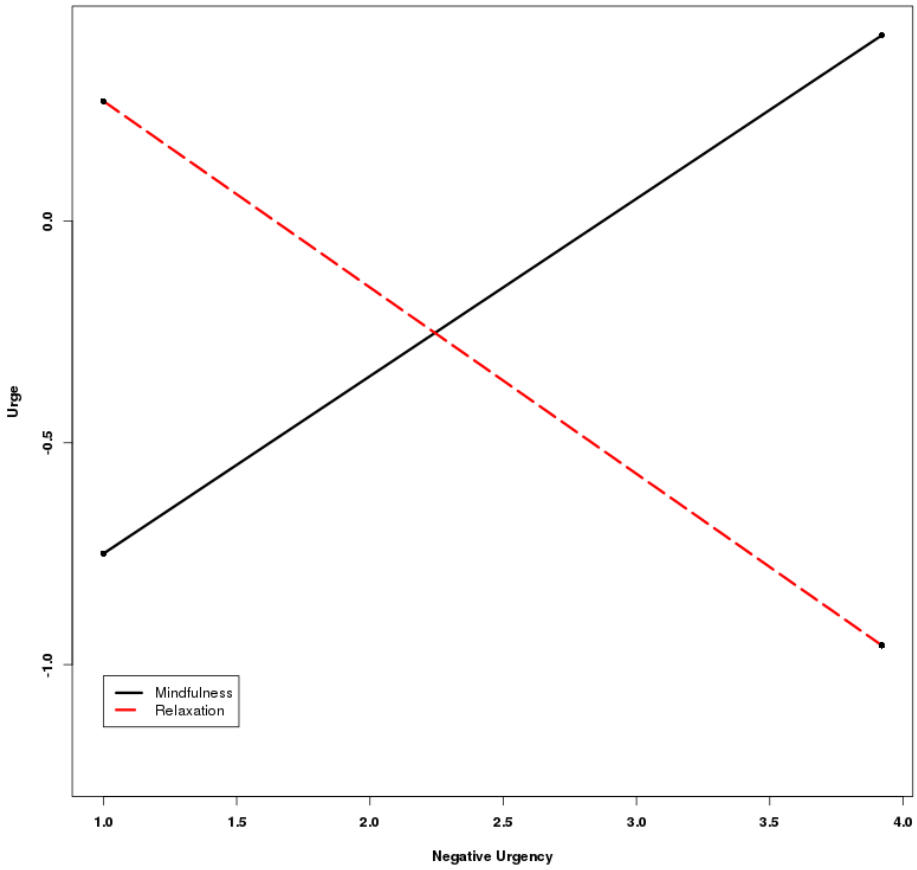

Figure 2. Significant interaction of intervention type and negative urgency on urge.

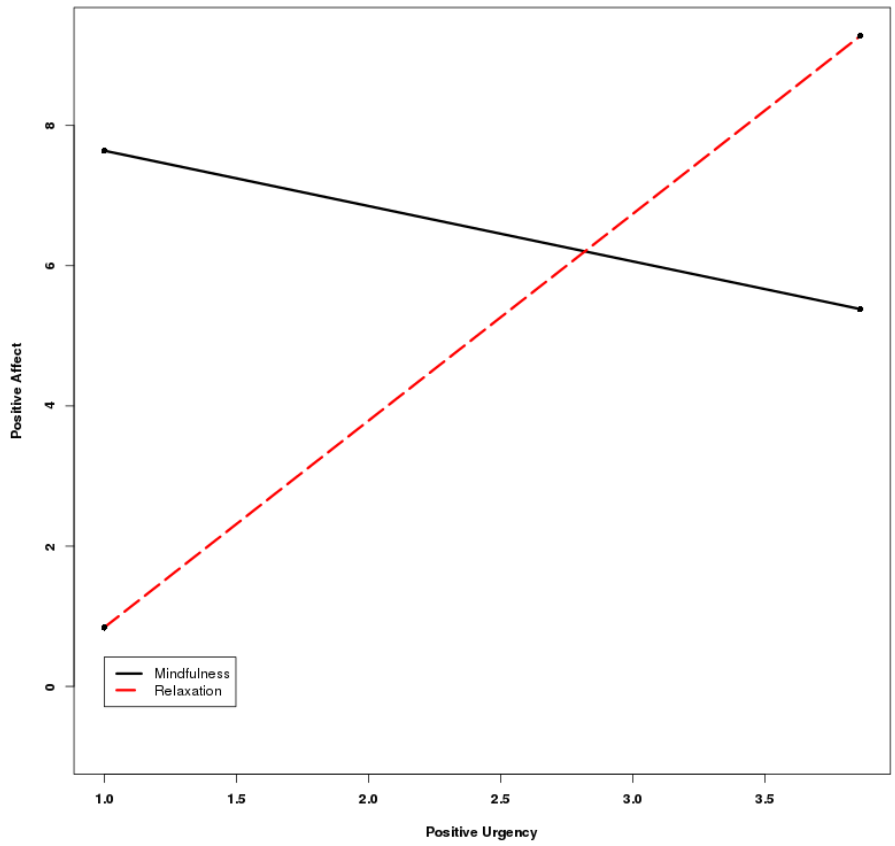

Figure 3. Significant interaction of intervention type and positive urgency on positive affect.

Highlights

- Examined trait impulsivity on affect and urge to drink in at-risk college drinkers
- Compared 3 brief interventions (mindfulness, relaxation, control)
- Mindfulness moderated the relationship between impulsivity and outcomes