

Elucidating the Association Between Trait Mindfulness and Alcohol Use Behaviors Among College Students

Kenny A. Karyadi · Melissa A. Cyders

Published online: 16 January 2015
© Springer Science+Business Media New York 2015

Abstract Trait mindfulness has been considered a protective factor against alcohol use behaviors; however, the specific trait mindfulness facets, the specific alcohol use behaviors, and the mechanism underlying this relationship remain unclear. The present study examined the relationship between specific trait mindfulness facets and specific alcohol use behaviors, and how cued alcohol cravings might mediate this relationship. High-risk, young adult, undergraduate social drinkers ($n=240$, 75 % Caucasian, 70 % female, mean age 19.4 years) completed a series of questionnaires and reported their level of alcohol cravings following alcohol pictorial cue exposure. Trait mindfulness was associated with less problematic alcohol use ($r=-0.19$, $p<0.01$) but was not associated with alcohol use quantity ($r=-0.07$, $p=0.30$) and duration ($r=-0.08$, $p=0.21$). Only acting with awareness was associated with all types of alcohol use behaviors—including less problematic alcohol use ($\beta=-0.18$, $p=0.02$), lower alcohol use quantity ($\beta=-0.16$, $p=0.04$), and shorter alcohol use duration ($\beta=-0.19$, $p=0.02$). Cued alcohol cravings mediated the negative associations of overall trait mindfulness ($b=-0.50$, $p<0.05$) and acting with awareness ($b=-0.32$, $p<0.05$) with problematic alcohol use, and the negative associations of acting with awareness with alcohol use quantity ($b=-1.24$, $p<0.05$) and alcohol use duration ($b=-0.34$, $p<0.05$). These findings suggest that the protective effect of trait mindfulness likely operates through reducing cued alcohol cravings and might be most specific to acting with awareness among college students, thus suggesting a differential role of separate trait mindfulness facets in this high risk group.

Keywords Trait mindfulness · Alcohol cravings · Alcohol cues · Alcohol use behaviors

K. A. Karyadi (✉) · M. A. Cyders
Indiana University-Purdue University, Indianapolis, USA
e-mail: kkaryadi@iupui.edu

Introduction

Alcohol use is common and often considered “normative” among college students; however, many college students endorse problematic alcohol use, including experiencing multiple and serious problems associated with their alcohol use (i.e., alcohol-related physical and sexual assaults, driving under the influence, etc.) (Hingson et al. 2009). Despite the high prevalence of problematic levels of alcohol use in undergraduate samples, many college students consume alcohol in non-problematic ways, suggesting that there are protective factors against problematic alcohol use.

One protective factor against problematic alcohol use in college students is trait mindfulness, which is conceptualized as a way of being that is focused on the present moment in a non-judgmental, non-reactive, and compassionate manner (Kabat-Zinn 2003). Individuals with higher levels of trait mindfulness are thought to be able to view aversive experiences as being transient rather than as experiences that should be avoided or acted upon (Kabat-Zinn 2003). In this way, individuals with higher levels of trait mindfulness might be less likely to resort to alcohol use as a way of coping with aversive experiences and less likely to subsequently develop problematic alcohol use. Indeed, trait mindfulness is negatively associated with alcohol use in both college student populations (Bramm et al. 2013; Christopher et al. 2012) and clinical populations (Bowen and Enkema 2014; Garland et al. 2012). However, this association is inconsistent across studies (Brooks et al. 2012; Eisenlohr-Moul et al. 2012; Shorey et al. 2014), likely due to the varied conceptualizations and measurements of trait mindfulness across studies.

In particular, according to Baer et al. (2006), trait mindfulness is comprised of five distinct facets: (1) observing (noticing or attending to internal and external experiences); (2) describing (labeling internal experiences with words); (3) acting with awareness (deliberately or consciously attending

to one's activities of the moment); (4) non-judgment (taking a non-evaluative stance toward thoughts and feelings); and (5) non-reactivity (tendency to allow thoughts and feelings to come and go without reacting to them). Using this conceptualization, a meta-analysis of 39 studies found that the trait mindfulness-substance use behaviors relationship differs across specific trait mindfulness facets and substance use behaviors: (1) only acting with awareness, non-judgment, and non-reactivity are negatively associated with substance use behaviors; and (2) trait mindfulness is more strongly related with problematic substance use behaviors as compared to non-problematic substance use behaviors (Karyadi et al. 2014). However, this meta-analysis did not examine trait mindfulness and its facets in relation to separate alcohol use behaviors (e.g., alcohol use duration, quantity, and problems), which can be differentially related to risk and protective factors.

Further work has sought to understand the mechanisms underlying the relationship between trait mindfulness and alcohol use behaviors. One potential mechanism involves the effects of cues on alcohol cravings and subsequent alcohol use behaviors. In general, exposure to alcohol cues (e.g., pictorial and odor cues) increases alcohol cravings among alcohol users (Mason et al. 2008; Sinha et al. 2008). In turn, cued alcohol cravings lead to greater alcohol seeking behaviors (Mason et al. 2008). However, among alcohol-dependent individual, trait mindfulness predicts greater ability to disengage attention from alcohol cues and reduces alcohol cravings following alcohol cue exposure (Garland 2011; Garland et al. 2010). In this way, trait mindfulness is thought to increase resiliency against alcohol cues, thus decreasing alcohol cravings (although this varies across specific mindfulness facets; see Garland 2009; Garland and Roberts-Lewis 2013; Garland et al. 2012; Witkiewitz et al. 2013) and subsequent alcohol seeking behaviors (Garland et al. 2012; Witkiewitz and Bowen 2010; Witkiewitz et al. 2013).

High exposure to alcohol cues in college settings can increase the risk for problematic alcohol use among college students (Ewing et al. 2010; Pavlick 2007; Ryan et al. 2010). As such, it is important to understand how trait mindfulness and its specific facets are related to resiliency to cued alcohol cravings and subsequent alcohol use behaviors in this high-risk population. The current study seeks to examine (1) how trait mindfulness and its facets are differentially related to separate alcohol use behaviors, and (2) how the relationships of trait mindfulness and its facets with alcohol use behaviors might be mediated by cued alcohol cravings. We hypothesized that (1) trait mindfulness will be differentially associated with alcohol use indicators—including problematic alcohol use, alcohol use duration, and alcohol use quantity; (2) trait mindfulness facets (e.g., observing, describing, acting with awareness, non-judgment, and non-reactivity) will be differentially associated with each of the three alcohol use indicators; and

(3) cued alcohol cravings will mediate the associations of trait mindfulness and trait mindfulness facets with each alcohol use indicator.

Method

Participants

Participants were recruited from introductory psychology courses at a Midwestern U.S. university and earned course credit for participation. All procedures were approved by an Institutional Review Board. Out of the initial sample ($n=457$), we excluded the following participants: (1) participants who were younger than 18 and older than 25, in order to focus our analyses on young adults, as recommended by NIAAA (2006); (2) participants who had not consumed alcohol in the past month in order to have a sample of college students who drink on at least a social level; and (3) participants who did not pass the manipulation test (see “*Measures*” below). The final sample consists of 240 participants.

Procedure

The study was advertised on a psychology experiment website. Students who were interested first completed a short eligibility survey online, which assessed target age, English fluency, and current alcohol consumption. Eligible students completed the study, which was approximately 1 h in duration, in a group format and in a classroom on campus. Participants first completed a larger battery of self-report questionnaires via an online survey—which included measures of demographics, social desirability, impulsivity, problematic alcohol use, alcohol use quantity and duration, alcohol-related consequences, alcohol cravings, and trait mindfulness (see Karyadi 2013). Participants were then presented with the alcohol picture set on the online survey, answered eight questions about the content of the pictures (see “*Measures*” below), and reported their cued alcohol cravings. They then saw the non-alcohol picture set, answered eight questions about the content of the pictures, and reported their alcohol cravings.

Measures

Mindfulness Trait mindfulness was assessed using the Five Facet Mindfulness Questionnaire (Baer et al. 2006). The scale consists of 39 items ($\alpha=0.85$ from the current sample), which assess different facets of trait mindfulness: non-judgment ($\alpha=0.87$), non-reactivity ($\alpha=0.69$), acting with awareness ($\alpha=0.85$), observing ($\alpha=0.78$), and describing ($\alpha=0.84$). Response options for all items range from (0) “Never or very rarely true” to (5) “Very often or always true.” Overall trait

mindfulness and specific trait mindfulness facets were calculated as separate means, with higher values indicating higher levels of trait mindfulness.

Alcohol Use and Cued Alcohol Cravings Problematic alcohol use was assessed using the Alcohol Use Disorder Identification Test (AUDIT; Babor et al. 1992). The AUDIT consists of 10 items ($\alpha=0.72$ from the current sample), which assess problematic patterns of alcohol use. The first eight items are rated on a 5-point Likert scale (e.g., 0=never to 4=daily), and items 9 and 10 are rated on a 3-point Likert scale (e.g., 0=no; 2=yes, but not during the last year; and 4=yes, during the last year). The AUDIT assesses multiple aspects of problematic alcohol use behaviors: (1) items 1–3 assess level of alcohol consumption; (2) items 4–6 assess alcohol dependence symptoms; and (3) items 7–10 assess negative alcohol consequences. The AUDIT was calculated as a summed value, ranging from 0 to 40, with higher summed values indicating greater levels of problematic alcohol use. Average summed value was 8.95 ($SD=4.72$) for problematic alcohol use. Based on the AUDIT manual, AUDIT scores in the range of 8 to 15 represent a medium level of problematic drinking and suggest a need for simple advice focused on reducing hazardous drinking (Babor et al. 1992).

Alcohol use quantity ($\alpha=0.70$ from the current sample) and duration ($\alpha=0.51$ from the current sample) were assessed using a modified version of the Daily Drinking Questionnaire (DDQ; Collins et al. 1986). Participants reported the number of drinks they had (alcohol use quantity) and the number of hours they were drinking (alcohol use duration) each day of the past week. These were calculated as separate summed values, with greater values indicating greater alcohol use quantity and duration in the past week. The average participants reported consuming 11.87 ($SD=15.15$) drinks in the past week, with an average of 2.47 ($SD=3.35$) drinks per day. The average participants reported spending 8.18 h ($SD=6.00$) drinking in the past week, with an average of 1.63 h ($SD=1.6$) of drinking per day. According to the National Institute on Alcohol Abuse and Alcoholism (2006), young adults might be at risk for alcohol-related problems if consumption exceeds 3–4 drinks per day.

Alcohol cues were a set of five color photographs previously shown to increase alcohol cravings (Field et al. 2007). After viewing the pictures, participants answered eight questions about the content of the pictures, as a manipulation check. Participants who incorrectly answered at least four of the eight questions were excluded from the sample. Following exposure to the pictorial cues, cued alcohol cravings were measured using the Alcohol Urge Questionnaire (AUQ; Bohn et al. 1995). The AUQ consists of 8 items, which assess a participant's urge for an alcoholic drink at the time the questionnaire is completed. Response options for AUQ items

ranged from (0) "Strongly disagree" to (6) "Strongly agree." The AUQ items were scored along a 7-point Likert scale and were calculated as a summed value, with higher values indicating greater cued alcohol cravings.

After being exposed to alcohol pictorial cues, participants were also exposed to a non-alcohol set of images, which was again comprised of five color photographs. After viewing these pictures, participants answered eight questions about the content of the pictures and re-rated their alcohol cravings using the AUQ. The inclusion of non-alcohol pictorial cues was mainly to determine whether alcohol cravings would differ between exposure to a non-alcohol set of images and exposure to an alcohol set of images. Using dependent samples *t* tests, alcohol cravings significantly differed between exposure to alcohol images ($M=8.66$, $SD=8.85$) and exposure to non-alcohol images ($M=7.63$, $SD=8.07$), $t(239)=6.05$, $p<0.0001$. In the current sample, the internal consistency coefficient was 0.84 for alcohol cravings following alcohol images and 0.80 for alcohol cravings following non-alcohol images.

Each alcohol and non-alcohol pictorial cue was in color and was presented on a separate page on the online survey. For the manipulation check, participants answered questions about the following: (1) the content of the pictures; (2) the characteristics of the pictures; and (3) whether non-human animals were present in some of the pictures. As part of the manipulation check, they were also asked to compare five sets of pictures, with each set containing two pictures, and to indicate which picture in each of the five sets was seen during the initial presentation of pictorial cues. For the manipulation check, the first three questions were presented on one page of the survey and each of the five picture sets was presented on a separate page. After answering the manipulation check questions, participants' alcohol cravings were assessed, with the measure of alcohol cravings being presented on one page of the survey. Although participants were instructed to pay attention to questions and pictorial cues presented in the survey, they were able to decide when to move on to the next page on the survey.

Data Analyses

We conducted several primary analyses: (1) bivariate correlational analyses to examine the associations among trait mindfulness and its facets, alcohol use indicators, and cued alcohol cravings; (2) simultaneous regression analyses to examine the association of each mindfulness facet with each alcohol use indicator, over and above other mindfulness facets; and (3) mediational analyses using the PROCESS macro for SPSS (Hayes 2012) to examine the direct and indirect associations of trait mindfulness and its facets with alcohol use indicators through cued alcohol cravings. All analyses were conducted using SPSS 19.0.

Table 1 Correlations and descriptives

Variables	1	2	3	4	5	6	7	8	9	10	11
1. AGE	1	0.15*	0.03	0.11	0.12	0.11	0.06	-0.06	-0.09	-0.08	-0.03
2. MIND		1	0.47*	0.70*	0.65*	0.54*	0.51*	-0.19*	-0.07	-0.08	-0.15*
3. OBS			1	0.32*	-0.06	0.45*	-0.23*	0.05	0.1	0.11	0.12
4. DES				1	0.30*	0.36*	0.1	-0.04	-0.06	-0.01	-0.14*
5. AW					1	0.03	0.48*	-0.22*	-0.14*	-0.18*	-0.18*
6. NREA						1	-0.05	-0.12	-0.05	-0.04	-0.02
7. NJUD							1	-0.19*	-0.03	-0.1	-0.17*
8. AUDIT								1	0.49*	0.49*	0.27*
9. AQU									1	0.57*	0.32*
10. ADU										1	0.23*
11. AUQ											1
Mean (SD)	19.37 (1.65)	2.25 (0.38)	2.31 (0.65)	2.43 (0.65)	2.13 (0.69)	2.07 (0.55)	2.29 (0.73)	8.95 (4.72)	11.87 (15.15)	8.18 (6.00)	8.66 (8.85)

MIND mindfulness, *OBS* observing, *DES* describing, *AW* acting with awareness, *NREA* non-reactivity, *NJUD* non-judgment, *AUDIT* problematic alcohol use, *AQU* number of drinks in the past week, *ADU* number of hours drinking in the past week, *AUQ* cued alcohol cravings

* $p < 0.05$

Results

Out of the 457 participants in the initial sample, we excluded 49 participants who were not between the ages of 18 and 25, 142 participants who had not consumed alcohol in the past month, and 26 participants who did not pass the manipulation test. Gender distribution did not significantly differ between excluded ($n=217$) and included ($n=240$) participants, $\chi^2(1, N=449)=0.003, p=0.96$. However, race distribution, age, and alcohol use behaviors did differ between the included and excluded participants (all $ps<0.05$)—with excluded participants being significantly older and more racially diverse, and consuming less alcohol. The final sample ($n=240$; 70 % female; 75 % Caucasian, 10.8 % African American, and 14.2 % comprising other races) had a mean age of 19.37 ($SD=1.65$). In this final sample, men reported greater alcohol use quantity ($M=15.25, SD=22.48$) compared to women ($M=10.56, SD=10.66$), $t(236)=2.18, p=0.03$. Overall trait mindfulness, specific trait mindfulness facets, problematic alcohol use, alcohol use duration, and cued alcohol cravings did not significantly differ across gender and race (all $ps>0.05$). See Table 1 for final sample characteristics, as well as mean levels of and correlations among study variables.

First, using bivariate correlational analyses (Table 1), we found that overall trait mindfulness was associated with less problematic alcohol use ($r=-0.19, p<0.01$) and lower cued alcohol cravings ($r=-0.15, p=0.02$). The pattern of relationships differed across trait mindfulness facets: acting with awareness was associated with less problematic alcohol use ($r=-0.22, p<0.01$), lower alcohol use quantity ($r=-0.15, p=0.03$), shorter alcohol use duration ($r=-0.18, p<0.01$), and lower cued alcohol cravings ($r=-0.18, p<0.01$). Non-judgment was associated with less problematic alcohol use ($r=-0.19, p<0.01$) and lower cued alcohol cravings ($r=-0.17, p<0.01$). Describing was associated with lower cued alcohol cravings ($r=-0.14, p=0.03$). Observing and non-reactivity were not significantly associated with cued alcohol cravings and all alcohol use behaviors ($r=-0.12$ – 0.12 , all $ps>0.05$).

Second, using simultaneous multiple regression analyses, we examined the associations of trait mindfulness facets with alcohol use quantity, alcohol use duration, and problematic alcohol use, while controlling for the effects of the other trait mindfulness facets. We controlled for age, race, and gender because they have been shown to influence alcohol use behaviors (Leigh and Stacy 2004; Nolen-Hoeksema 2004; Wallace et al. 2003). We entered all trait mindfulness facets and demographic covariates in the same step. Acting with awareness ($\beta=-0.19, p=0.01$) and non-reactivity ($\beta=-0.18, p=0.02$) were the only facets associated with less problematic alcohol use. Furthermore, acting with awareness was the only facet associated with lower alcohol use quantity ($\beta=-0.17, p=0.03$), and observing was the only facet associated with

greater alcohol use quantity ($\beta=0.16, p=0.04$). Finally, acting with awareness was the only facet associated with shorter alcohol use duration ($\beta=-0.17, p=0.03$). Overall, acting with awareness was the only trait mindfulness facet consistently associated with different types of alcohol use behaviors, over and above other trait mindfulness facets.

Third, using the PROCESS macro for SPSS (Hayes 2012), we conducted a series of mediational analyses to examine the direct and indirect associations of trait mindfulness and its facets with problematic alcohol use, alcohol use quantity, and alcohol use duration. Using bootstrapping, direct and indirect associations are significant if the 95 % confidence intervals (CI) do not contain zero. Because trait mindfulness was correlated only with problematic alcohol use and because only acting with awareness was associated with different types of alcohol use behaviors, we examined only these specific associations in follow-up mediation analyses. Cued alcohol cravings was entered as the mediator, and age, race, and gender were entered as covariates in all analyses. We conducted individual analyses using separate alcohol use behaviors as dependent variables and trait mindfulness and its facets as independent variables.

Overall trait mindfulness had a significant negative direct association ($b=-1.85, SE=0.79, 95\% \text{ CI} [-3.42, -0.31]$) and a significant negative indirect association through cued alcohol cravings ($b=-0.50, SE=0.24, 95\% \text{ CI} [-1.10, -0.11]$) with problematic alcohol use. Similarly, acting with awareness had a significant negative direct association ($b=-1.23, SE=0.44, 95\% \text{ CI} [-2.09, -0.38]$) and a significant negative indirect association through cued alcohol cravings ($b=-0.32, SE=0.14, 95\% \text{ CI} [-0.63, -0.09]$) with problematic alcohol use. Furthermore, acting with awareness had a significant negative indirect association with alcohol use quantity through cued alcohol cravings ($b=-1.24, SE=0.59, 95\% \text{ CI} [-2.68, -0.37]$), but a non-significant direct association ($b=-2.03, SE=1.39, 95\% \text{ CI} [-4.76, 0.71]$). Finally, acting with awareness had a significant indirect negative association with alcohol use duration through cued alcohol cravings ($b=-0.34, SE=0.56, 95\% \text{ CI} [-0.86, -0.08]$), but a non-significant direct association ($b=-1.10, SE=0.56, 95\% \text{ CI} [-2.21, 0.009]$).

Discussion

Interestingly, trait mindfulness is negatively associated only with problematic alcohol use, but not with the quantity and duration of alcohol use. These findings are consistent with findings from previous work with college students (Bramm et al. 2013; Christopher et al. 2012) and findings from a recent meta-analysis (Karyadi et al. 2014), but inconsistent with other work that has linked trait mindfulness to other aspects of alcohol use behaviors (Eisenlohr-Moul et al. 2012; Leigh

and Neighbors 2009) and that has failed to find a relationship (Brooks et al. 2012; Garland et al. 2012; Shorey et al. 2014). Importantly, the current study suggests that collapsing across different trait mindfulness facets might explain inconsistencies across these studies (Smith et al., 2003). In this study, only acting with awareness is associated with all three types of alcohol use behaviors, over and above other trait mindfulness facets. Although these findings are consistent with previous work linking acting with awareness with multiple aspects of alcohol use behaviors, including problematic alcohol use (Bodenlos et al. 2013; Leigh and Neighbors 2009), some studies have found that other trait mindfulness facets are also related to different aspects of alcohol use behaviors (Fernandez et al., 2012; Murphy and MacKillop 2012).

These findings suggest that college students with higher levels of overall trait mindfulness might be at reduced risk for developing problematic levels of alcohol use (Bodenlos et al. 2013; Ostafin and Marlatt, 2008) but might not necessarily have lower rates of alcohol use quantity and duration. At the same time, college students who specifically have higher levels of acting with awareness might be at lower risk for developing problematic levels of alcohol use, likely through reduced alcohol consumption in general (Fernandez et al. 2010; Leigh and Neighbors 2009; Murphy and MacKillop 2012). This is consistent with prior theories, which suggest that individuals who can attend to their activities in the present moment might be less automatically reactive toward aversive experiences and might consequently become less likely to automatically engage in alcohol use behaviors (Fernandez et al., 2007; Ostafin and Marlatt, 2008). In this way, college students with higher levels of acting with awareness might generally consume alcohol less problematically because they are less affected by aversive experiences.

Other work has supported the role of trait mindfulness in alcohol use behaviors. Participation in mindfulness interventions reduces substance cravings (Chiesa and Seretti 2014; Witkiewitz et al. 2013) and substance use behaviors (Bowen et al. 2014; Chiesa and Seretti 2014; Witkiewitz et al. 2014), likely by addressing many aspects associated with trait mindfulness—such as avoidance (Bowen et al. 2007), self-regulation (Wupperman et al. 2012), and emotional awareness (Price et al. 2012). These findings, as well as data from the present study, support the viability of a causal model in which trait mindfulness protects against alcohol use behaviors. Support of this model through future studies would suggest that the choice of mindfulness interventions might depend on treatment goals. If the goal is to mitigate problematic alcohol use, general mindfulness training might be appropriate (Chiesa and Seretti 2014). In contrast, if the goal is to reduce general alcohol consumption and the risk for problematic alcohol use behaviors, the specific cultivation of acting with awareness through training might be most effective (Bowen et al. 2007; Price et al. 2012). This targeted approach could

result in more focused and effective intervention choices, but should be examined more fully in future work.

The present study also found that cued alcohol cravings might be the mechanism through which trait mindfulness and acting with awareness influence alcohol use. These findings extend on previous experimental findings, wherein trait mindfulness reduces the effects of alcohol cues on alcohol cravings (Garland 2011; Garland et al. 2010). Specifically, trait mindfulness might reduce problematic alcohol use behaviors, but not alcohol use quantity and duration, by reducing the effects of alcohol cues on alcohol cravings. Relatedly, acting with awareness might protect against alcohol use quantity, duration, and problems by reducing the effects of alcohol cues on alcohol cravings. In this way, college students with higher levels of trait mindfulness—particularly acting with awareness—might experience lower alcohol cravings because they are less reactive to alcohol cues, which would consequently make them less likely to seek and consume alcohol. If targeting trait mindfulness and specifically targeting acting with awareness can reduce alcohol cravings in response to cues, general and targeted mindfulness interventions could be efficient in addressing both the protective factors and the mechanism that affect alcohol use and abuse (Bowen and Marlatt 2009; Rogojanski et al. 2011; Witkiewitz et al. 2013).

There are limitations in the present study. First, because the current study is cross-sectional, the mediational analyses should be seen as an initial statistical test of a theory that should be replicated and expanded in future studies; however, previous theory and empirical work do support the current study's directional model. Second, it is unclear how the model might look in more diverse, non-college student, clinical, and older samples. However, given the large rates of problematic alcohol use among young adult college students (Hingson et al. 2009), a better understanding of protective factors in this high-risk population is important and significant. Third, there are limitations due to experimental design: the use of pictorial cues rather than other alcohol cues (e.g., smell or taste of alcohol), the lack of counterbalancing of alcohol and non-alcohol pictures, group format rather than individual format for study participation, completion of self-report questionnaires prior to experimental manipulation, presentation of manipulation checks prior to alcohol cravings assessment, and the omission of assessing previous mindfulness training or duration of the study or the time of day when the study was conducted. These aforementioned limitations limit the generalizability of the findings and should be addressed in future work. Finally, in order to examine the viability of the clinical implications of the current work, future work should examine direct manipulation of specific trait mindfulness facets through targeted mindfulness interventions, and the effects of such targeted attempts on cued alcohol cravings and subsequent alcohol use behaviors.

Overall, findings of the present study suggest that (1) the relationship between trait mindfulness and alcohol use behaviors differs across separate types of alcohol use behaviors and across specific mindfulness facets, and (2) trait mindfulness might protect against alcohol use behaviors in part by reducing alcohol cravings that follow the exposure to alcohol cues. The present study's findings suggest that the protective effect of trait mindfulness in college students differs in context of specific alcohol use behaviors and trait mindfulness facets, and likely operates through reducing cued alcohol cravings. The present study serves as a necessary first step in testing a causal model of how trait mindfulness affects the risk for problematic alcohol use behaviors through the reduction of cued alcohol cravings.

Acknowledgments This research was supported by a National Institute on Alcohol Abuse and Alcoholism training grant fellowship, T32 AA07462, awarded to Kenny A. Karyadi.

References

- Babor, T. F., de la Fuente, J. R., Saunders, J., & Grant, M. (1992). *The alcohol use disorders identification test: guidelines for use in primary health care*. Geneva: World Health Organization.
- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*, 27–45.
- Bodenlos, J. S., Noonan, M., & Wells, S. Y. (2013). Mindfulness and alcohol problems in college students: the mediating effects of stress. *Journal of American College Health, 61*, 371–378.
- Bohn, M. J., Krahn, D. D., & Staehler, B. A. (1995). Development and initial validation of a measure of drinking urges in abstinent alcoholics. *Alcoholism: Clinical and Experimental Research, 19*, 600–606.
- Bowen, S., & Enkema, M. C. (2014). Relationship between dispositional mindfulness and substance use: findings from a clinical sample. *Addictive Behaviors, 39*, 532–537.
- Bowen, S., & Marlatt, A. (2009). Surfing the urge: brief mindfulness-based intervention for college student smokers. *Psychology of Addictive Behaviors, 23*, 666–671.
- Bowen, S., Witkiewitz, K., Dillworth, T. M., & Marlatt, G. A. (2007). The role of thought suppression in the relationship between mindfulness meditation and alcohol use. *Addictive Behaviors, 32*, 2324–2328.
- Bowen, S., Witkiewitz, K., Clifasefi, S. L., Grow, J., Chawla, N., Hsu, S. H., & Larimer, M. E. (2014). Relative efficacy of mindfulness-based relapse prevention, standard relapse prevention, and treatment as usual for substance use disorders: a randomized clinical trial. *JAMA Psychiatry, 71*, 547–556.
- Bramm, S. M., Cohn, A. M., & Hagman, B. T. (2013). Can preoccupation with alcohol override the protective properties of mindful awareness on problematic drinking? *Addictive Disorders and Their Treatment, 12*, 19–27.
- Brooks, M., Kay-Lambkin, F., Bowman, J., & Childs, S. (2012). Self-compassion amongst clients with problematic alcohol use. *Mindfulness, 3*, 308–317.
- Chiesa, A., & Seretti, A. (2014). Are mindfulness-based interventions effective for substance use disorders? A systematic review of the evidence. *Substance Use and Misuse, 49*, 492–512.
- Christopher, M., Ramsey, M., & Antick, J. (2012). The role of dispositional mindfulness in mitigating the impact of stress and impulsivity on alcohol-related problems. *Addiction Research and Theory, 21*, 429–434.
- Collins, R. L., Parks, G. A., & Marlatt, G. A. (1986). Social determinants of alcohol consumption: the effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology, 53*, 189–200.
- Eisenlohr-Moul, T. A., Walsh, E. C., Charnigo, R. J., Lynam, D. R., & Baer, R. A. (2012). The “what” and the “how” of dispositional mindfulness using interactions among subscales of the five-facet mindfulness questionnaire to understand its relation to substance use. *Assessment, 19*, 276–286.
- Ewing, S. W. F., Filbey, F. M., Chandler, L. D., & Hutchison, K. E. (2010). Exploring the relationship between depressive and anxiety symptoms and neuronal response to alcohol cues. *Alcoholism: Clinical and Experimental Research, 34*, 396–403.
- Fernandez, A. C., Wood, M. D., Stein, L. A. R., & Rossi, J. S. (2010). Measuring mindfulness and examining its relationship with alcohol use and negative consequences. *Psychology of Addictive Behaviors, 24*, 608–616.
- Field, M., Duka, T., Eastwood, B., Child, R., Santarcangelo, M., & Gayton, M. (2007). Experimental manipulation of attentional biases in heavy drinkers: do the effects generalize? *Psychopharmacology, 192*, 593–608.
- Garland, E. L. (2009). Biopsychosocial Assessment of a Mindfulness-Oriented Cognitive Intervention for Alcohol Dependent Adults (Doctoral dissertation, University of North Carolina).
- Garland, E. L. (2011). Trait mindfulness predicts attentional and autonomic regulation of alcohol cue-reactivity. *Journal of Psychophysiology, 25*, 180–189.
- Garland, E. L., & Roberts-Lewis, A. (2013). Differential roles of thought suppression and dispositional mindfulness in posttraumatic stress symptoms and craving. *Addictive Behaviors, 38*, 1555–1562.
- Garland, E. L., Gaylord, S. A., Boettiger, C. A., & Howard, M. O. (2010). Mindfulness training modifies cognitive, affective, and physiological mechanisms implicated in alcohol dependence: results of a randomized controlled pilot trial. *Journal of Psychoactive Drugs, 42*, 177–192.
- Garland, E. L., Boettiger, C. A., Gaylord, S., Chanon, V. W., & Howard, M. O. (2012). Mindfulness is inversely associated with alcohol attentional bias among recovering alcohol-dependent adults. *Cognitive Therapy and Research, 36*, 441–450.
- Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling. Retrieved from <http://www.afhayes.com/public/process2012.pdf>.
- Hingson, R. W., Zha, W., & Weitzman, E. R. (2009). Magnitude and trends in alcohol-related mortality and morbidity among U.S. college students ages 18–24, 1998–2005. *Journal of Studies on Alcohol and Drugs, 16*, 12–20.
- Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: past, present, and future. *Clinical Psychology: Science and Practice, 10*, 144–156.
- Karyadi, K. A. (2013). The Interactive Effects of Alcohol Cravings, Cue Reactivity, and Urgency on College Student Problematic Drinking (Master's thesis, Indiana University Purdue University in Indianapolis).
- Karyadi, K. A., VanderVeen, J. D., & Cyders, M. A. (2014). A meta-analysis of the relationship between trait mindfulness and substance use behaviors. *Drug and Alcohol Dependence, 143*, 1–10.
- Leigh, J., & Neighbors, C. (2009). Enhancement motives mediate the positive association between mind/body awareness and college student drinking. *Journal of Social and Clinical Psychology, 28*, 650–669.

- Leigh, B. C., & Stacy, A. W. (2004). Alcohol expectancies and drinking in different age groups. *Addiction, 99*, 215–227.
- Mason, B. J., Light, J. M., Escher, T., & Drobles, D. J. (2008). Effect of positive and negative affective stimuli and beverage cues on measures of craving in non treatment-seeking alcoholics. *Psychopharmacology, 200*, 141–150.
- Murphy, C., & MacKillop, J. (2012). Living in the here and now: interrelationships between impulsivity, mindfulness, and alcohol misuse. *Psychopharmacology, 219*, 527–536.
- National Institute on Alcohol Abuse and Alcoholism (2006). Alcohol Alert: Young Adult Drinking. <http://pubs.niaaa.nih.gov/publications/aa68/aa68.htm>. Retrieved October 13, 2014.
- Nolen-Hoeksema, S. (2004). Gender differences in risk factors and consequences for alcohol use and problems. *Clinical Psychology Review, 24*, 981–1010.
- Pavlick, M. N. (2007). The relationship of cue-exposure, reactivity, and craving in binge-drinking college students (Doctoral dissertation, Bowling Green State University).
- Price, C. J., Wells, E. A., Donovan, D. M., & Rue, T. (2012). Mindful awareness in body-oriented therapy as an adjunct to women's substance use disorder treatment: a pilot feasibility study. *Journal of Substance Abuse Treatment, 43*, 94–107.
- Rogojanski, J., Vettese, L. C., & Antony, M. M. (2011). Coping with cigarette cravings: comparison of suppression versus mindfulness-based strategies. *Mindfulness, 2*, 14–26.
- Ryan, J. J., Kreiner, D. S., Chapman, M. D., & Stark-Wroblewski, K. (2010). Virtual reality cues for binge drinking in college students. *Cyberpsychology, Behavior and Social Networking, 13*, 159–162.
- Shorey, R. C., Brasfield, H., Anderson, S., & Stuart, G. L. (2014). The relation between trait mindfulness and early maladaptive schemas in men seeking substance use treatment. *Mindfulness, 1–8*.
- Sinha, R., Fox, H. C., Hong, K. A., Bergquist, K., Bhagwagar, Z., & Siedlarz, K. M. (2008). Enhanced negative emotion and alcohol craving, and altered physiological responses following stress and cue exposure in alcohol dependent individuals. *Neuropsychopharmacology, 34*, 1198–1208.
- Wallace, J. M., Brown, T. N., Bachman, J. G., & Laveist, T. A. (2003). The influence of race and religion on abstinence from alcohol, cigarettes and marijuana among adolescents. *Journal of Studies on Alcohol and Drugs, 64*, 843–848.
- Witkiewitz, K., & Bowen, S. (2010). Depression, craving and substance use following a randomized trial of mindfulness-based relapse prevention. *Journal of Consulting and Clinical Psychology, 78*, 362–374.
- Witkiewitz, K., Bowen, S., Douglas, H., & Hsu, S. H. (2013). Mindfulness-based relapse prevention for substance craving. *Addictive Behaviors, 38*, 1563–1571.
- Witkiewitz, K., Warner, K., Sully, B., Barricks, A., Stauffer, C., Thompson, B. L., & Luoma, J. B. (2014). Randomized trial comparing mindfulness-based relapse prevention with relapse prevention for women offenders at a residential addiction treatment center. *Substance Use and Misuse, 49*, 536–546.
- Wupperman, P., Marlatt, G. A., Cunningham, A., Bowen, S., Berking, M., Mulvihill-Rivera, N., & Easton, C. (2012). Mindfulness and modification therapy for behavioral dysregulation: results from a pilot study targeting alcohol use and aggression in women. *Journal of Clinical Psychology, 68*, 50–66.