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Posttraumatic Stress and Problem Drinking at the Transition out of College

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Abstract

Objective—The objective of the present study was to examine how symptoms of posttraumatic stress disorder (PTSD) may confer drinking risk as students with trauma histories complete college and move toward independent adulthood.

Method—Students (N = 283) completed assessments of trauma, posttraumatic stress, and alcohol use and consequences at four time points during the year following their 4th year of college. Some students had transitioned out of the college environment whereas others had not. We examined how transition status moderated within-person associations between changes in PTSD and corresponding changes in alcohol outcomes over time. Using multilevel modeling, we examined differences in within-person PTSD-alcohol associations comparing students who were: (1) continuing as 5th year seniors, (2) graduated and pursuing graduate education, and (3) graduated and left the university setting.

Results—Alcohol use and consequences tended to decline on average from the 4th to 5th year post matriculation. Yet, within-person increases in posttraumatic stress symptomatology across the 5th year were associated with greater alcohol consequences, but only for those students who had left the university setting.

Conclusions—These data suggest that the transition out of college may be an important developmental context that is associated with increased vulnerability for negative consequences from stress-related drinking. Findings may have important implications for campus-based prevention efforts geared toward the facilitation of a successful transition into independent adulthood.

Keywords

Trauma; posttraumatic stress; alcohol; college students; transition from college; maturing out

Introduction

During young adulthood, individuals move into and out of new roles, relationships, and environments (Arnett, 2000, 2005). For a sizable proportion of young adults in the U.S., these shifts coincide with transitions into and out of college. Developmental theories highlight the critical mental health significance of such transitions from one life stage to the next (Bronfenbrenner, 1979; Elder, 1998; Lerner, 1982; Schulenberg, Bryant, & O'Malley, 2004). These transitions represent challenges to developmental systems which if not successfully navigated, lead to a cascade of problematic behavioral outcomes, including alcohol misuse.

Heavy alcohol consumption and related problems have been well documented among college students (Chassin, Sher, Hussong, & Curran, 2013; Johnston, O'Malley, Bachman, & Schulenberg, 2013). Though some students “mature out” of such heavy use after college, others do not (Lee et al., 2013). An understanding of these divergent pathways could inform the development of interventions designed to enhance the likelihood of a successful transition out of college.

Once thought to be a protected population with regard to mental health problems, an emerging literature has underscored the significant mental health challenges that college students may face (Bieter et al., 2015; Blanco et al., 2008; Eisenberg et al., 2011). Trauma and posttraumatic stress are among these challenges. Approximately two thirds of college students report trauma exposure and approximately nine percent endorse symptoms consistent with a posttraumatic stress disorder (PTSD) diagnosis (Read, Ouimette, White, Colder, & Farrow, 2011; Smyth, Hockemeyer, Heron, Wonderlich, & Penedaker, 2008). Many more students report post-trauma symptomatology which, despite falling below somewhat arbitrary diagnostic thresholds, is impairing nonetheless (McDevitt-Murphy et al., 2007; Read et al., 2011; Smyth et al., 2008). Trauma and posttraumatic stress (PTSD) have been linked to harmful or hazardous drinking in young adults (Kaysen et al., 2014; Read et al., 2012; Simpson et al., 2014), and may be among the factors that account for non-resolution of problem drinking as young adults transition through their third decade of life.

The link between PTSD and deleterious drinking outcomes is believed to be due - at least in part - to a self-medication process whereby individuals with PTSD use alcohol in an effort to alleviate their symptoms (Baily & Stewart, 2014; Khantzian, 2003). From this perspective, it is expected that drinking and alcohol-related consequences occur in dynamic response to changes in PTSD symptoms. Examination of self-medication processes in young adults has yielded mixed findings (Colder, 2001; Gottfredson & Hussong, 2011; Hussong, Gould, & Hersh, 2008; Read, Merrill, Griffin, Bachrach, & Khan, 2014; Read et al., 2012; Simpson, Stappenbeck, Luterek, Lehavot, & Kaysen, 2014). The strongest evidence for such processes in these populations comes from within-person studies at both the daily level and over longer periods of time (Simons, Wills, & Neal, 2014; Simpson et al., 2014; Kaysen et al., 2013; Wardell, Read, & Colder, 2013), as such designs allow for examination of symptoms and drinking outcomes in close proximity to one another. Further, within-person designs can be used to examine how changes in symptoms relate to changes in drinking over time, controlling for between-person differences (Curran & Bauer, 2011).

Problem drinking in relation to PTSD symptoms may be especially important during developmental challenges such as transitions from one life context to another. Graduation from college is such a transition. This is a time of dramatic change (Osgood, 2005; Settersten, 2007); as students transition out of college, they leave familiar settings, routines, peer groups, and identities. Moreover, the kinds of transitions that young adults make during this time are variable, with some students pursuing post-baccalaureate education and others transitioning out of the educational environment entirely. Different types of transitions may have unique implications for drinking risk.

The change and uncertainty that are inherent to these transitions can intensify existing vulnerabilities for substance misuse (Schulenberg, Bryant, & O'Malley, 2004). Trauma and posttraumatic stress represent such a vulnerability, as those with these histories may struggle to manage PTSD symptoms against the backdrop of changing environments, relationships, and roles. Therefore, the link between PTSD and drinking may be stronger for those in the midst of such transitions (Gottfredson & Hussong, 2011; Valdez, Bailey, Santuzzi, & Lilly, 2014). Further, trauma re-exposure is unfortunately common (Briere & Runz, 1987; Roodman & Clum, 2001), and repeated exposure has been shown to exert a particularly toxic influence on a variety of outcomes, including substance involvement (Ford et al., 2010; Read et al., 2011; Zayfert, 2011). As such, developmental transitions may be especially challenging for those with multiple traumas.

Factors that portend drinking risk at the transition into college - including PTSD - have been well studied (e.g., Barnett et al., 2014; Borsari, Murphy, & Barnett, 2007; Dalton & Galambos, 2009; Fromme et al., 2008; Read, Colder, Merrill, Ouimette, White, & Swartout, 2012). Yet little attention has been paid to the transition out of college. This is unfortunate, as examinations of risk during this transition could shed light on what factors may contribute to or inhibit the successful resolution of problem alcohol involvement (i.e., maturing out), and may inform the development of interventions geared toward a successful transition into independent adulthood.

To address this gap, the objective of the present study was to examine longitudinal within-person associations between PTSD symptoms and drinking outcomes in a sample of college students during the transitional period of their 5th year post-matriculation. We expected that, within individuals, increased PTSD symptoms at a given point in time would be associated with greater alcohol use and problems. We also expected transition status (i.e., whether students had graduated and departed from the university environment, or had either pursued post-baccalaureate education or a 5th year of undergraduate studies) to moderate these associations, such that the associations would be stronger for those transitioning from the college environment.

Method

Participants

Sample and procedure—The present sample was drawn from a larger longitudinal study examining associations among trauma, posttraumatic stress, and substance use in college students. Recruitment procedures for this sample have been reported in detail elsewhere

(Read, Ouimette, White, Colder, & Farrow, 2011; Read et al., 2012). Data were collected via web-based surveys; the cohort (1 of 3) used in the current study was enrolled in their first year of undergraduate studies at the University at Buffalo in fall of 2006. Surveys were administered multiple times per year. Participants were given a one-month window within which to complete each survey and were compensated with gift cards for survey completion. The present analyses focused on the period that typically corresponds to the beginning of the transition out of the college environment, encompassing the academic year that follows the first 4 years of university. For the present analyses, participants completed surveys at 4 time points over their 5th post-matriculation year: September (T1), December (T2), February (T3), and April (T4). At each assessment, participants reported on alcohol use and consequences, trauma exposure, and PTSD symptoms. Each time point leading up to T1 of the present study was completed by approximately 91% ($n=41$ lost to attrition) of the cohort. There was no evidence of differential attrition based on PTSD.

The present study sample—Given that we were interested in studying PTSD-alcohol associations, we limited the sample only to those who had reported a DSM IV-TR-defined criterion A trauma (i.e., Trauma exposure, accompanied by the subjective experience of fear, helplessness, or horror; APA, 2000) at some point during the first 4 years of the study ($N=341$ of a possible 440 participants). Of these eligible participants, 16 participants reported having left college without graduating (e.g. taking time off, dropped out), 31 were lost to study attrition (i.e., did not complete any of the 4 time points in the 5th year), and 11 (3%) had missing data on educational status, personality, or alcohol consequences, and thus were not included in analyses. Accordingly, the final sample consisted of 283 trauma-exposed participants (72.8% female, 75.27% Caucasian).

At T1, 91.87% of the sample was 22 years of age (range = 22-26). The majority (75.3%, $n=213$) of the sample were White, 14.5% ($n=41$) were of Asian ethnicity, 4.6% ($n=13$) were Black, 1.8% ($n=5$) were Hispanic. Less than 1% of the sample ($n=2$) identified as American Indian/Alaskan or Hawaiian/Pacific Islander. Approximately 3% ($n=9$) of the sample identified as being Biracial. There were no differences on alcohol consequences across these groups. Though there was a significant omnibus test for the alcohol use across groups, post hoc tests could not be conducted because groups were too small. To examine the effect of transition status on the PTSD-alcohol association, those included in the analyses had either (1) just graduated from college and had transitioned to the post-college environment ($n = 103$), (2) were just starting graduate school or other post-baccalaureate study ($n = 83$), or (3) were still in college (e.g., 5th year senior; $n = 97$), based on self-report data collected at T1.

Measures

Demographics—Participants reported on demographic characteristics including sex, age, and educational status.

Trauma exposure and PTSD symptoms—Trauma exposure was assessed using the Traumatic Life Events Questionnaire (TLEQ; Kubany et al., 2000). Criterion A1 (exposure) and A2 (subjective response) were assessed consistent with the DSM-IV-TR PTSD criteria. Participants were asked to report all new traumas that were experienced since the last time

point. Thus, measurement of trauma exposure was continuous. Past month PTSD symptoms were assessed at each time point using the PTSD Checklist- Civilian Version (APA; 2000; PCL; Weathers et al., 1993). The summed total of 17 symptoms endorsed at each time point were used as an indicator of PTSD symptom severity (T1 $\alpha = .91$, T2 $\alpha = .89$ T3 $\alpha = .90$, T4 $\alpha = .89$).

Alcohol use—Participants were asked about past month alcohol use. Participants who reported drinking alcohol at least once during this period were asked to complete additional questions about their alcohol use. All participants were provided with a standard drink measurement chart to enhance reporting accuracy. Frequency was measured with the item, “(In the past month), how often have you had some kind of beverage containing alcohol?” Response options ranged from 0=*never in the past month* to 6=*every day*. The typical number of drinks per occasion in the past month was assessed with an item asking about number of standard drinks usually consumed on a drinking occasion (ranging from 0 to 9 or more; Wood, Read, Palfai and Stevenson, 2001). Quantity-frequency (QF) indices were created by multiplying item responses to create a metric reflecting overall alcohol consumption in the past month.

Alcohol consequences—Alcohol consequences were assessed using the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006). Participants provided dichotomous (yes/no) endorsement of any of 48 alcohol-related consequences within the past month at each time point. The sum of all 48 consequences is the alcohol consequence total score (T1 $\alpha = .93$, T2 $\alpha = .94$ T3 $\alpha = .93$, T4 $\alpha = .92$).

Trait Negative Affect—To isolate the unique influences of PTSD, we controlled for trait negative affect assessed at T1 in all models. We assessed trait negative affect with the Neuroticism subscale (8 items) of the Big Five Inventory (BFI; John & Srivastava, 1999). Participants responded to each item using a 5-point Likert scale, with possible scores ranging from 8 to 40. The Neuroticism subscale demonstrated good internal reliability (T1 $\alpha = .84$).

Data Analytic Plan

Multilevel modeling was conducted with SPSS Statistics version 21 (IBM, 2012) to examine longitudinal, within-person associations of PTSD symptom severity with alcohol use and consequences, and whether these associations depended on college transition status. Alcohol use and alcohol consequences at the 4 assessment points were examined in separate models as outcomes nested within participants. In both models (i.e., alcohol use, alcohol consequences), PTSD symptom severity and new criterion A trauma exposure (0 = no, 1 = yes) at each time point were entered as time-varying predictors, and these variables were person-mean centered to represent within-person effects at each time point. Also, each participant's average PTSD symptoms over the 4 time points and a person-level mean criterion A exposure variable (representing the proportion of time points with a new criterion A event) were entered as between-person covariates in the model (grand mean centered). College transition status was represented by two orthogonal, contrast-coded variables, the first comparing those who had graduated and transitioned out of the college environment to

those who were still in the college environment (i.e., thus including both undergraduate and graduate students). The second contrast compared those who were still undergraduate students to those who had started graduate school. Finally, we entered sex (centered; women = -.27, men = .73) and trait negative affect (i.e., neuroticism; grand mean centered) as between-person covariates to control for their potential influence on the alcohol outcomes.

To examine whether PTSD symptom associations with alcohol use and consequences were moderated by transition status, we entered the two-way interactions between the transition status contrasts and the person-centered changes in PTSD symptoms (moderation of within-person associations) as well as the two-way interactions between the transition contrasts and person-level average PTSD symptoms (to examine moderation of the between-person associations). To isolate the unique moderating effect of transition status (a between-person variable) from the potential moderating effects of the between-person covariates (sex, trait negative affect, and degree of trauma re-exposure), all interactions among the PTSD variables and the between-person covariates were also entered. We planned to probe significant interactions using simple slopes analyses (Aiken & West, 1991), conditioning the PTSD-alcohol associations on each of the transition status groups.

We used a model building approach to specify the appropriate random effects structure. We began by first entering all fixed effects in the model and specifying a random intercept for the clustering variable (i.e., participant). We then tested whether the inclusion of the random slope for each of the within-person covariates (i.e., person-centered PTSD and trauma variables) led to improvements in model fit by conducting likelihood ratio tests. As we expected correlations between individual intercepts and slopes, we specified an unstructured covariance matrix for the random effects. We planned to retain those random effects that contributed significantly to model fit improvement. Restricted Maximum Likelihood Estimation (REML) was used for the analyses.

Results

Descriptive Statistics

The types of traumas most frequently reported in our sample were related to death or illness a loved one and sexual or other interpersonal aggression and violence. For example, the trauma types endorsed most frequently included physical or sexual assault ($n = 233$), sudden or unexpected death of someone close ($n = 209$), an unwanted aggressive experience (i.e., sexual attention, stalked, threatened; $n = 187$), and life threatening illness or injury of someone close ($n = 135$). These patterns of trauma type were relatively consistent across the assessment period.

Across year 5 time points (T1-T4), the sample scored an average of 25.54 ($SD = 9.86$) on the PTSD Checklist (PCL), an average of 8.59 ($SD = 7.51$) on the alcohol QF index, with 3.42 ($SD = 5.10$) alcohol-related consequences on average in the past month. See Table 1 for descriptive information on these variables by transition group status in year 5 as well as year 4 for comparison. Findings indicated differences in transition status groups on sex, average alcohol use, and alcohol-related consequences; those who transitioned out of undergraduate status drank more alcohol and experienced more alcohol-related consequences than those

who remained undergraduates. The three groups did not differ on PTSD symptoms or on trauma re-exposure. Those in graduate school also endorsed marginally higher baseline rates of neuroticism than those still in college at T1. Mean levels of alcohol use, consequences, and PTSD symptoms over the year of interest were not markedly variable; thus, examination of mean level change was not justified.

For comparison, we also examined whether the groups differed in terms of their average PTSD symptoms, alcohol use, and alcohol consequences across the assessments in the 4th year of college (i.e., leading up to the transition, see again Table 1). The same pattern of differences was observed on all of these variables in year 4. That is, we observed no group differences on average PTSD symptoms ($p=.251$), whereas greater alcohol use and consequences in Year 4 were observed among those who will leave the college environment or become graduate students in year 5 relative to those who will still be undergraduates in year 5 ($ps < .05$). This consistency in group differences was not surprising given the strong correlations between year 4 and year 5 alcohol use ($r=.83$, $p<.001$) and consequences ($r=.76$, $p<.001$).

Multilevel Models

Missing data—Eighty percent of the sample ($n = 226$) had complete data on all variables across the 4 assessment points, and 93% ($n = 263$) had complete data at all but one of the four assessments. The overall proportion of missing data points was low ($<5\%$). Across each assessment point, the number of participants missing data were $n=7$ at T1, $n=19$ at T2, $n=23$ at T3, and $n=32$ at T4. Participants who were missing data at one or more time points ($n=57$) did not differ from those with complete data at all time points ($n=226$) on graduation status, sex, negative affect, or year 5 average PTSD symptoms, alcohol use or alcohol consequences (all $ps > .05$).

Random effects specification—For both the alcohol use and consequences models, including the random slope for the within-person effect of PTSD symptoms led to significant improvement in model fit relative to the random intercept-only models ($\chi^2(2)=19.73$, $p<.001$ for alcohol use; $\chi^2(2)=55.13$, $p<.001$ for alcohol problems). However, in neither model was the inclusion of the random slope for the time-varying effect of Criterion A trauma re-exposure associated with improvement in model fit ($\chi^2(2)=5.61$, $p=.06$ for alcohol use; $\chi^2(2)=4.32$, $p=.12$ for alcohol problems). Thus, this variable was modeled as a fixed effect only. The intraclass correlation coefficients were .25 for alcohol use and .35 for alcohol consequences.

Alcohol use model—Table 2 shows the fixed effects from the multilevel model with alcohol use as the outcome. As shown, there were no significant interactions between college transition status and either the within-person or between-person PTSD symptom variables, suggesting that PTSD-alcohol use associations did not depend on transition status. However, there were significant interactions between sex and both within-person and between-person PTSD variables. Simple slopes analyses conditioning the effects of PTSD symptoms on each sex revealed that the between-person association of PTSD symptoms and alcohol use was not significant for women ($B = -0.06$, $SE = 0.06$, $p = .318$), but was

significant and negative for men ($B = -0.30$, $SE = 0.08$, $p < .001$). This suggests that men who reported greater levels of PTSD symptoms on average over the course of the year also reported lower overall levels of alcohol use.

Simple slopes analysis revealed that, though associations diverged in direction for women ($B = 0.05$, $SE = 0.03$, $p = .141$) and men ($B = -0.08$, $SE = 0.05$, $p = .118$), within-person associations were not statistically significant for either sex.

Alcohol Consequences Model—Table 2 shows the results of the multilevel model with alcohol consequences as the outcome. As hypothesized, we observed a significant interaction between within-person changes in PTSD symptoms and college transition status (those who graduated and left the college environment vs. those who were still students), indicating that this association differed across groups. However, there was no interaction between PTSD symptoms and the contrast comparing undergraduate vs. graduate students. Moreover, between-person levels of PTSD symptoms did not interact with transition status, nor did any of the other between person covariates (sex, trait negative affect, level of criterion A exposure) interact significantly with either within-person or between-person effects of PTSD status (see Table 2).

Simple slopes analyses (Figure 1) conditioning the within-person association between PTSD symptoms and alcohol consequences on each of the three transition groups revealed that this association was significant and positive for those who had graduated and left the college environment ($B = 0.13$, $SE = 0.04$, $p = .006$), but not for those still in the college environment ($B = 0.01$, $SE = 0.04$, $p = .824$ for undergraduate students; $B = 0.01$, $SE = 0.06$, $p = .916$ for graduate students). In other words, within-person increases in PTSD symptoms at a given time point were associated with corresponding increases in alcohol consequences, but only for students who had recently transitioned out of the college environment.

Discussion

Our findings show that students who have transitioned out of the college environment have a greater likelihood of experiencing negative alcohol consequences during periods of within-person increases in PTSD symptomatology. Thus, as students leave college, risk-pathways such as those associated with negative affect not only remain, but may even be potentiated by the transition from college. We discuss our findings and their implications below.

Seminal work by Bronfenbrenner (1979) emphasized the importance of understanding behavioral outcomes within the context of “ecological transitions” - which reflect periods during which an individual's position in his or her environment is altered by a change in role, setting, or both (pg. 26). Consistent with this notion, in this study, within-person PTSD and alcohol consequence associations were observed for those who had left the college environment, but not for those still in college, or even those pursuing graduate education. This was independent of overall average levels of PTSD symptoms, and was observed despite slight declines observed in mean alcohol use and consequences from year 4 to year 5 regardless of transition status. Moreover, this pattern of within-person PTSD-alcohol consequences unique to those transitioning out of the college environment was evident

despite the fact that average levels of alcohol use and consequences were higher in both of the groups that had transitioned from undergraduate status (i.e., those who left the college environment and those who pursued post-baccalaureate education) relative to those who remained in undergraduate studies. This is important, as it suggests that stress vulnerability may be especially evident in the context of the changing environment, such that dynamic changes in PTSD symptoms are more strongly predictive of co-occurring negative alcohol consequences among those transitioning out of the relative familiarity of the college setting.

Though it has sometimes been presumed that college departure marks a dramatic downward shift in alcohol involvement, more recent evidence suggests that the process of maturing out is a more gradual one, and one that is affected by a number of factors (Lee et al., 2015; Littlefield et al., 2009). At least some prior work suggests that negative affect, a hallmark characteristic of posttraumatic stress, is one such factor that may play an important role in this process (Littlefield et al., 2009). Findings here are concordant with this work.

The moderating effects of transition status were observed only for associations between PTSD and alcohol consequences, and not for alcohol use. This is consistent with a large literature that has linked negative affect symptoms such as PTSD to alcohol problems specifically, and not simply to alcohol consumption (e.g., Cooper et al., 1995; Martens et al., 2008; Simons, Gaher, Oliver, Bush, & Palmer, 2005). As such, in our study, PTSD symptoms are linked dynamically not to more drinking, but to more problems related to consumption when drinking does occur (Curran & Bauer, 2011; Read, Wardell, & Colder, 2013; Skiwinski et al., 2009). From this, we suggest that preventative interventions for those with PTSD may focus on reducing risk for harmful outcomes (e.g., increasing engagement in protective behaviors; Larimer et al., 2007; Martens et al., 2007), rather than seeking to decrease drinking *per se*.

Though prior work has linked trauma re-exposure to worsening outcomes (Ford et al., 2010; Kaltman et al., 2005; Meyers et al., 2006; Read et al., 2011; Zayfert, 2012) in our study we did not find evidence that trauma re-exposure predicted unique variance in alcohol use or consequences. Nor did levels of trauma re-exposure moderate associations between PTSD symptoms and alcohol outcomes. In this sample, rates of re-exposure were relatively low over the 8-month period of assessment, and this may account for the apparent absence of a re-exposure effect on PTSD-alcohol outcome associations.

We also did not find mean levels of PTSD symptoms across the assessment interval to be significantly associated with between-person differences in alcohol use or alcohol problems. The literature shows that associations between PTSD and alcohol outcomes emerge most commonly when alcohol is measured either temporally proximal or in dynamic relation to PTSD symptoms (Kaysen et al., 2014; Najdowski, & Ullman, 2009; Read et al., 2004; Zlotnick et al., 1999). Our finding that alcohol consequences were dynamically linked with PTSD symptom variability over time within individuals, and not with average PTSD symptom levels is consistent with this.

Our findings pertaining to PTSD-alcohol associations among those pursuing graduate study are novel, and somewhat surprising. Unlike students in our sample who had graduated and

left the university environment, PTSD-alcohol consequence associations were not significantly associated for those students who had graduated, but still were in a university setting (i.e. those pursuing graduate study). This was true even though drinking and consequences were higher among graduate students relative to 5th year seniors. This is intriguing in what it says not only about those transitioning out of the university environment, but also about what it may suggest about those who stay on beyond the undergraduate years. These findings point to graduate students as a population of interest for future studies of alcohol involvement in higher education settings. Though there is a modest-sized literature on problem drinking behaviors in medical students (Ketoja et al., 2013; Shah et al., 2009), examinations of such drinking practices among graduate students in other disciplines have been few. Studies of risk and protective factors within this educational context may shed light on the evolving nature of alcohol consumption across the developmental lifespan.

There is a large literature highlighting overlap between PTSD and a general tendency toward negative affect (Armour et al., 2015; Blanchard et al., 1998; Breslau & Schultz, 2013). Indeed, a criticism of the PTSD construct is that it is not always distinguishable from negative affectivity more broadly (e.g., Simms et al., 2002). It was with this literature in mind that we included trait neuroticism in our models, in an effort to isolate processes that are unique to PTSD. That we did not observe moderating effects for general negative affect offers evidence of PTSD's specific association with alcohol outcomes.

Our finding that men who reported greater average levels of PTSD symptoms also reported lower levels of alcohol use was unexpected. This association was not significant for women, and was observed only for alcohol use and not for consequences. Though one possible conclusion from this finding is that for men, PTSD is protective against drinking (but not against alcohol-related consequences) during this developmental period, we offer this conclusion only tentatively. This finding was not predicted, and to our knowledge, there is no theory or prior data that would suggest such a protective mechanism. Replication is needed before firmer conclusions can be drawn.

With this study there are limitations as well as some questions that remain unaddressed. First among these is that, though we were able to isolate PTSD symptoms as a unique risk factor for alcohol consequences among those transitioning from college, we were not able to rule out a number of “third variable” explanations that may account for the associations we observed. These could include unmeasured between-person effects such as self-regulatory traits (e.g., impulsivity, negative urgency, emotion regulation) which have been implicated in negative affect-related drinking (e.g., Menary et al., 2015; Weiss et al., 2013). Also, as grouping participants based on transition status does not involve random assignment, it also is possible that there are unmeasured factors associated with transition status that could account for the relationship between transition status and the within-person associations that we observed. Further, as drinking differences across transition groups were evident prior to the end of the 4th year, this study cannot speak to a temporal relationship between transition status and drinking changes. It is important to note that the focus of this work is to highlight the ways in which PTSD symptomatology may be linked with risk during the important developmental period that is the transition out of college. Findings from this study do not

suggest that this period of transition is causing the differences that we observed. Such a mechanism was not what we sought to test in this study, and cannot be gleaned from our data.

Beyond possible third variable explanations, there also are a number of potential moderators not examined in this study. As developmental transitions are a period during which coping demands may be at their highest, individual variability in coping (i.e., coping deficits) and level of social support may be particularly relevant. Similarly, key environmental factors at this specific developmental transition such as role changes may be especially difficult to navigate when also coping with symptoms of posttraumatic stress. Future research is necessary to improve our understanding of the complex interaction between the individual and the environment at such a transition and the vulnerability that traumatic stress symptoms may present.

We examined the influence of PTSD on patterns of alcohol use and problems, consistent with a self-medication framework. Alternative conceptualizations include that problem alcohol involvement may have deleterious influence on PTSD symptoms (Bremner et al., 1996; Bisby et al., 2009; Read et al., 2013), or that PTSD and alcohol involvement may influence one another over time (Read et al., 2013). Neither of these alternative pathways can be ruled out in this study.

Lastly, our sample is not fully representative of the U.S. college population, with overrepresentation of women, and those identifying as being of Asian descent, and underrepresentation of individuals identifying as Black. (US NCES, 2015). Moreover, there was not adequate ethnic representation to determine whether PTSD-alcohol associations at this transition were consistent across students of various ethnicities.

Prevention Implications and Conclusions

Our findings suggest that PTSD-associated drinking outcomes may be exacerbated during the tumultuous transition from college. Given the myriad challenges facing young adults as they move from college life and into independent adulthood, the months leading up to college graduation could be an ideal time for preventive intervention. Though many universities provide incoming students with information regarding the negative consequences of heavy drinking, to our knowledge, there currently are no interventions to reduce drinking risk in those preparing for another important developmental transition, the transition from college. The present findings may inform the development of such interventions. For example, a brief motivational intervention (BMI) might be created to be delivered to students as they approach the end of college to encourage reflection on drinking behaviors, and how drinking may be linked to PTSD symptoms. This intervention also could help students to anticipate some of the challenges ahead as they transition from the college environment and how posttraumatic stress may play a role in these challenges.

These findings also highlight some potentially important prevention and intervention directions for those engaged in graduate study. As noted, research on problem drinking in graduate settings has been scarce. Findings here suggest that these students may be a high risk group with respect to heavy drinking and related outcomes. We have been unable to find

any published studies on the development or testing of interventions to reduce alcohol-related harm in this group of young adults. This may be an important direction for targeting preventive efforts.

In summary, the present findings offer an important first-step toward understanding factors which may contribute to hazardous drinking practices in young adults who have been exposed to trauma, and may also inform prevention efforts geared toward the facilitation of a successful transition into independent adulthood for those coping with trauma and its effects.

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Statement of Compliance with Ethical Standards: Ethical Approval. As noted, this study was approved by the University at Buffalo, SUNY IRB. Participants' right to privacy was not infringed. The manuscript contains no identifying participant information. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent. As noted in the Method section, in collecting data for this paper, we followed APA ethical guidelines. Informed consent was obtained from all participants included in the study.

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Figure 1.
Simple slopes for the within-person association between PTSD symptoms and alcohol consequences conditioned on college transition status.

Table 1
Descriptive Statistics by Group (Means and Standard Deviations)

	Post-College Environment	Graduate Student	Still in College	Test	<i>p</i>
Female n(%)	76 (73.8%)	68 (81.9%)	62 (63.9%)	$\chi^2 = 7.41^*$	0.03
Neuroticism	3.12 (.81)	3.32 (.84)	3.03 (.83)	$F = 2.78$	0.06
Proportion of new trauma – Year 5	.07 (.16)	.06 (.14)	.08 (.16)	$F = .52$	0.60
Average PTSD symptoms – Year 5	25.10 (9.34)	24.56 (9.64)	26.85 (10.53)	$F = 1.37$	0.26
Average alcohol use – Year 5	10.38 (8.58) ^a	9.08 (7.68) ^a	6.24 (5.30) ^b	$F = 8.24^{**}$	< .01
Avg alc consequences – Year 5	4.21 (5.48) ^a	3.93 (5.94) ^a	2.13 (3.42) ^b	$F = 4.85^{**}$	< .01
Average PTSD symptoms – Year 4 [/]	26.52 (10.10)	25.03 (9.84)	27.52 (9.95)	$F = 1.39$	.25
Average alcohol use – Year 4	11.59 (8.71) ^a	10.22 (7.36) ^a	6.95 (5.78) ^b	$F = 10.20$	< .01
Avg alc consequences – Year 4	4.55 (5.80) ^a	4.49 (6.24) ^a	2.82 (4.19) ^b	$F = 3.12^*$	.05

Notes. Means that do not share a superscript letter in common were significantly different in post-hoc comparisons.

[/]One participant was missing all Year 4 data on PTSD symptoms.

* $p < .05$,

** $p < .01$

Fixed effects estimates from multilevel models predicting alcohol use and alcohol consequences from PTSD symptoms and college transition status.

Table 2

	Alcohol Use			Alcohol Consequences		
	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>P</i>
Level 1 (within person)						
Criterion A trauma	0.80	0.69	.242	0.50	0.61	.414
PTSD Symptoms	0.01	0.03	.687	0.05	0.03	.110
Level 2 (between person)						
Criterion A trauma	4.67	3.33	.162	3.88	2.34	.098
PTSD Symptoms	-0.13 [*]	0.05	.014	0.01	0.04	.824
Sex	1.50	1.02	.142	0.87	0.72	.229
Trait Negative Affect (NA)	-0.09	0.57	.874	0.01	0.40	.973
Transition Contrasts						
Out of college vs. Still student (Contrast 1)	-1.89 ^{**}	0.60	.002	-0.86 [*]	0.42	.044
Undergrad vs. Grad student (Contrast 2)	2.75 [*]	1.12	.015	1.89 [*]	0.79	.017
Cross-level Interactions						
PTSD symptoms (level 1) * Sex (level 2)	-0.13 [*]	0.06	.032	-0.03	0.06	.690
PTSD symptoms (level 1) * NA (level 2)	0.01	0.03	.730	0.04	0.03	.258
PTSD symptoms (level 1) * Criterion A trauma (level 2)	-0.08	0.13	.530	-0.13	0.15	.369
PTSD symptoms (level 1) * Transition contrast 1 (level 2)	-0.03	0.03	.416	-0.08 [*]	0.04	.035
PTSD symptoms (level 1) * Transition contrast 2 (level 2)	-0.01	0.06	.881	0.00	0.07	.953
Between-Person Interactions						
PTSD symptoms (level 2) * Sex (level 2)	-0.24 [*]	0.11	.026	-0.11	0.07	.139
PTSD symptoms (level 2) * NA (level 2)	-0.01	0.05	.860	-0.02	0.04	.680
PTSD symptoms (level 2) * Criterion A trauma (level 2)	-0.17	0.28	.554	-0.26	0.20	.185
PTSD symptoms (level 2) * Transition contrast 1 (level 2)	0.07	0.06	.255	-0.03	0.04	.498
PTSD symptoms (level 2) * Transition contrast 2 (level 2)	-0.11	0.12	.371	0.02	0.08	.831

^{*} p<05;

10>d
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