Latent Profiles of Alcohol Consumption Among College Students Exposed to Trauma

Kaitlin E. Bountress, PhD ⭘ Sage E. Hawn, PhD ⭘ Danielle M. Dick, PhD ⭘
Spit for Science Working Group ⭘ Ananda B. Amstadter, PhD

Abstract

Background: Alcohol use/misuse is a costly public health problem, particularly among college students in the United States. Alcohol use tends to increase during adolescence and peaks in the early/mid-20s; however, there is significant heterogeneity among alcohol use during the college years. Several studies applying a mixture modeling framework to extract latent profiles of alcohol consumption have been conducted. However, none to our knowledge has included only those exposed to trauma, a group known to be at risk for alcohol misuse. The aim of this longitudinal study ($n = 1,186$) was to identify profiles of alcohol consumption and their associations with demographic and trauma-related constructs.

Method: Data were collected from a larger study of college students attending a large public university. Participants in the current study were, on average, 18.46 years old at study entry, primarily female (69.6%), and of diverse racial/ethnic backgrounds (e.g., 48.8% White, 20.4% Black, 16.8% Asian).

Results: Results suggest evidence for four latent profiles. These classes include an initially high increasing, an initially high decreasing, an initially low decreasing, and an initially low increasing, the last of which had not been found. Using analyses of variance, profile membership was associated with number of traumas, probable posttraumatic stress disorder, broad drinking motives, and trauma-specific drinking-to-cope motives.

Conclusions: Results suggest that drinking motives and trauma-related factors are important correlates of these latent alcohol profiles. Work clarifying the longitudinal interrelations between profile membership and these factors is needed to help inform more effective prevention and intervention efforts.

Keywords: Alcohol Consumption, College Students, Growth Mixture Models, Trauma Exposure

Kaitlin E. Bountress, PhD, and Ananda B. Amstadter, PhD, Virginia Institute for Psychiatry and Behavioral Genetics, Virginia Commonwealth University.

Sage E. Hawn, PhD, Virginia Institute for Psychiatry and Behavioral Genetics, Virginia Commonwealth University; and Department of Psychology, Virginia Commonwealth University.

Danielle M. Dick, PhD, Department of Psychology, Virginia Commonwealth University.

Alcohol use in the United States is prevalent and constitutes a serious public health concern, particularly among emerging adults and on college campuses. Individuals aged 18–25 years are most likely to consume alcohol (57.1%) and engage in problematic alcohol use, compared with any other age group (Ahrnsbrak et al., 2017). Compared with age-based peers who are not college students, those attending college show an increased risk for alcohol misuse (Barnes et al., 2010; Johnston et al., 2014). College student alcohol misuse is very problematic as it is associated with lower grade point average (Musgrave-Marquart et al., 1997; Singleton, 2007; Williams et al., 2003), discontinuous enrollment (Arria et al., 2013), and reduced educational attainment (King et al., 2006), all of which may have long-term outcomes across a variety of life and health domains.

Studies investigating the developmental trajectory of alcohol use show that consumption increases during adolescence

and college-age years and decreases starting around the mid-20s (Chen & Jacobson, 2012). However, there is a variability within this "average" trajectory (Brunborg et al., 2017; Maggs & Schulenberg, 2004). Recent advancements in latent growth curve mixture modeling have identified unique profiles of alcohol consumption, varying from three (Casswell et al., 2002; Chassin et al., 2002), four (Brunborg et al., 2017; Danielsson et al., 2010; Van Der Vorst et al., 2009), to five (Berg et al., 2013; Toumbourou et al., 2004; Van Der Vorst et al., 2009) profiles of alcohol consumption. Despite the numerous numbers of profiles found across the extant studies, they generally converge in producing profiles showing continually low, continually moderate, continually high, initially high and then reducing, and initially lower with acute periods of high levels of use. However, there are some limitations of the existing studies. Specifically, prior studies have (a) failed to account for trauma or trauma-related distress, either in the sampling or in relation to profile membership; (b) have tended to focus on a very narrow adolescent age range (e.g., 13–15 years); or (c) present data using long time lags between measurement occasions (e.g., ages 16, 22, 32, and 43 years). It is particularly problematic that prior work has not examined profiles of alcohol use among those exposed to trauma because this group is known to be at risk for alcohol misuse (Ullman et al., 2005). College is an ideal developmental period in which to examine changes in alcohol use, as individuals in late adolescence/early adulthood (i.e., 16–25 years old) are at a greatest risk for exposure to trauma and the development of posttraumatic stress disorder (Breslau et al., 1998).

This interrelation between trauma and alcohol misuse has frequently been explained by the "drinking to cope" self-medication framework. This theory posits that individuals exposed to trauma drink to cope with trauma-related distress (Khantzian, 1990; Langdon et al., 2017). Interestingly, most studies have only examined enhancement (Grayson & Nolen-Hoeksema, 2005; Simpson et al., 2014), social (Hofmann et al., 2003), and conformity (Ham & Hope, 2003) motives, as well as general drinking to cope with broad negative affect motives (e.g., cope subscale of the Drinking Motives Questionnaire-Revised; Cooper, 1994). That is, they have ignored motives related to drinking to cope with trauma-related symptoms specifically (O'Hare & Sherrer, 2011; Waldrop et al., 2007). Therefore, it is not clear whether drinking to cope with negative affect more generally (e.g., "To cheer you up when you are in a bad mood") is synonymous with drinking to cope with trauma-related symptoms. Thus, there is a need to compare the role of more general drinking-to-cope motives and trauma-specific drinking to cope in examining this "drinking to cope" effect. The current study will add to this literature by examining trajectories of alcohol consumption among those with a trauma history. The current study will also test associations between these latent profiles and trauma-related as well as broad drinking motives.

In addition to drinking motives, other relevant factors, such as trauma-related constructs and parental substance use, have been linked to problematic alcohol use. For instance, both anxiety and depression, which have been associated with trauma exposure and posttraumatic stress disorder (Kessler et al., 2005), tend to co-occur with problematic alcohol use. Specifically, anxiety disorders and alcohol dependence influence one another (Kushner et al., 2000). Similarly, the presence of either alcohol use disorder or depression doubles the risk of developing the other disorder (Boden & Fergusson, 2011). In addition, parental substance use also increases risk for adolescent substance use directly (e.g., modeling, genetic risk) and indirectly (e.g., via increased risk for physical and assault; Kilpatrick et al., 2000). Finally, the number of traumas that one has experienced is associated with a range of psychiatric outcomes (Turner & Lloyd, 1995). Thus, the current study examines whether anxiety, depression, parent substance use disorder, and number of traumas are associated with latent profiles of alcohol consumption.

Improving our understanding of factors that impact alcohol trajectories among those with a trauma history may help inform clinical efforts and is warranted given the relation between problematic alcohol use and adverse outcomes (Wechsler et al., 1996; White & Hingson, 2013). Therefore, this study aimed to extend the current knowledge in two primary ways. First, it aims to investigate profiles of alcohol consumption among college-aged individuals exposed to trauma. Second, this study will examine differences between these profiles on a number of demographic, drinking motives, and trauma-related constructs. As no study to date has extracted profiles of alcohol consumption among trauma-exposed individuals, these aims were exploratory in nature. We were particularly curious whether the previously identified profiles would be replicated or whether new profiles might be discovered. Given the potential for differences across these factors, we included gender, race, cohort, parent substance use disorder, number of traumas specifically, drinking motives, anxiety symptoms, depressive symptoms, and posttraumatic stress disorder symptoms as predictors.

MATERIALS AND METHOD
Overarching Study Sample
Participants for the current project came from a large, ongoing longitudinal study of behavioral and emotional well-being of college students at a mid-Atlantic public university. This study was approved by the university's review board. Additional information about the larger study recruitment and data collection can be found elsewhere (blinded for Review 1). Baseline and follow-up data were collected on four consecutive cohorts during the fall and spring, respectively, of participants' first year of college. Surveys were completed online through Research Electronic Data Capture (Harris et al., 2009), a secure, web-based application designed to support data capture for research studies. Of the 14,959 individuals who were eligible to complete the study's baseline fall assessment across four cohorts, 9,889 participated (average of 2,472 per cohort). Participants were, on average, 18.5 years old at baseline, 38.2% were male, 61.1% were female, and 0.7%

declined to identify their gender. The sample reflected the population from which it was drawn: 49.4% White, 18.9% African American, 16.3% Asian, 6% Hispanic/Latino, and 9.4% other/multirace/unknown/declined to respond.

Those who completed the baseline survey were invited via email to complete a follow-up assessment between Weeks 7 and 14 of the spring semester of their freshman year. Of those who completed the baseline assessment and who were still enrolled at the university, 4,820 completed the follow-up assessment (59% retention). Individuals were invited to complete a survey during the spring of each subsequent year (e.g., spring sophomore year, spring junior year). Of those individuals who were interviewed in the fall of their freshman year, there were no differences between those who were and were not retained in the spring of their senior year in terms of race. However, individuals who were still participating in the study by the spring of their senior year were slightly younger (18.49 vs. 18.55, $t = 5.263$, $p < .001$; Cohen's $d = .14$) and female (65.8%) compared with those who were not retained (61.6%, $\chi^2 = 4.593$, $p < .05$; Cramer's $V = .08$). As these effects are small, there is less concern about differences between those retained and not retained.

Current Study Sample

Of the individuals in Cohorts 1–4 of the larger study, 7,006 were contacted in the fall of 2016[1] about participating in a spin-off study (funding blinded for review) because they met the following study inclusion criteria: had endorsed at least one lifetime trauma as well as lifetime alcohol use. The intention of the spin-off survey was to gather more in-depth information about participant posttraumatic stress disorder symptoms, trauma history, and trauma-related drinking to cope. Of the initial 7,006 who were contacted, 2,100 (30%) expressed an interest in participating in this spin-off study and were emailed a survey link. Of these students, 1,759 (83.4%) enrolled in the spin-off survey at the time of data analysis and 1,711 completed the survey in full (2.7% began but did not complete the survey). The present sample ($n = 1,186$) included spin-off survey participants who had four time points of measurement (needed to test for the quadratic longitudinal growth curve model; Preacher, 2010), from the parent study (i.e., belonged to Cohorts 1–3), and had one or more assessments of alcohol consumption from the larger parent study. There were no differences between those in the larger study who were and were not included in the spin-off survey in terms of race. However, those included in the spin-off survey were younger (18.46 vs. 18.51, $t = 4.43$, $p < .01$; Cohen's $d = .14$) and more likely to be female (69.9%), compared with those in the larger study who were not included (60.3%; $\chi^2 = 40.553$, $p < .001$; Cramer's $V = .08$). Again, as these are small effects, there is less concern about these group differences.

Measures

See Table 1 for descriptive information on study constructs.

Main Constructs of Interest for Mixed Model Alcohol consumption (measured in fall freshman year and each spring after) Participants reported on their recent alcohol use with ordinal frequency and quantity items from the Alcohol Use Disorders Identification Test (Bush et al., 1998). These frequency and quantity items were combined to create a single "grams of ethanol consumed per month" variable using a method previously reported in (blinded for Review 2) and utilized by (blinded for Review 3). Because this variable was highly skewed (skew range: 4.57–5.52) and kurtotic (kurtosis range: 31.75–44.40), it was log transformed, with the resulting skew (skew range: −1.07 to −0.16) and kurtosis (kurtosis range: −1.46 to 0.49) much improved.

Constructs on Which Latent Groups May Differ Demographics Participants reported their gender, cohort, and race. To maximize power to detect differences between groups, individuals were coded as being in one of the three largest groups, namely, White, African American, and Asian, or were coded as "Other."

Parent substance use disorder (measured in fall freshman year) Individuals reported whether their biological mother or father had a problem with alcohol or drugs.

Depressive and anxiety symptoms (measured in fall freshman year) Participants reported their depressive and anxiety symptoms in the past week using items from the Symptom Checklist-90 Revised (Todd et al., 1997). This measure asks participants about their symptoms using a 5-point scale (0 = *not at all*, 4 = *extremely*). A sum of the five depression items (e.g., feeling blue, blaming yourself for things), as well as the five anxiety items (e.g., nervousness or shakiness, worrying too much), was created (Cronbach's alphas = .79–.84)

Probable posttraumatic stress disorder (measured in fall freshman year) A modified version of the Primary Care-Posttraumatic Stress Disorder screener (Prins et al., 2016) was administered. This measure assessed whether the participant's trauma had resulted in nightmares, avoiding situations or thoughts of the event, feeling constantly on guard or easily startled, or feeling numb or detached from others/surroundings.

Drinking motives (measured in fall freshman year) Motives for using alcohol were assessed via the Drinking Motives Questionnaire-Revised (Cooper, 1994). Participants answered whether they used alcohol for a number of reasons, including to be social (e.g., to celebrate special occasions), cope with distressing feelings (e.g., to forget about my problems), make activities more pleasurable (i.e., enhancement; e.g., gives me a pleasant feeling), or conform (e.g., because my friends pressure me to drink). Responses were coded from 1 (*almost never/never*) to 5 (*almost always/always*). Internal consistency for subscales was adequate (e.g., between .87 and .92).

Total number of traumatic events endorsed (measured in the spin-off study) Individuals reported on interpersonal traumatic events before college using the Traumatic Life Events Questionnaire (Kubany et al., 2000). This measure contains

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[1]It should be noted that additional attempts to reach potential participants occurred in the fall of 2017. However, the data obtained from fall 2016 surveys comprised the first "data freeze" and the sample from which the current study participants come.

TABLE 1	Descriptive Information on Study Constructs (N = 1,186)		
	Mean (*SD*) or %	Skew	Kurtosis
Gender	69.9% female	–	–
White	48.8%	–	–
African American	20.4%	–	–
Asian	16.8%	–	–
Race: other	14%	–	–
Cohort 1	27.7%	–	–
Cohort 2	29.3%	–	–
Cohort 3	43%	–	–
Parent substance use disorder	31.1%	–	–
Freshmen fall probable posttraumatic stress disorder	36.3%	–	–
Freshmen fall anxiety symptoms	6.9 (3.06)	1.75	3.35
Freshmen fall depression symptoms	8.87 (3.59)	0.89	0.41
Freshmen fall drinking motives: conformity	1.36 (0.65)	1.94	3.22
Freshmen fall drinking motives: cope	1.79 (0.95)	0.91	–0.37
Freshmen fall drinking motives: enhance	2.83 (0.88)	–0.60	–0.46
Freshmen fall drinking motives: social	3.48 (0.82)	–1.67	2.23
Spin-off survey: lifetime interpersonal traumas	9.60 (9.31)	2.19	7.72
Spin-off survey: drinking to cope	1.55 (0.93)	1.88	3.10
Spin-off survey: posttraumatic stress disorder PCL symptoms	14.40 (16.58)	1.50	1.79
Freshmen fall alcohol consumption (log transformed)	1.39 (1.16)	–0.80	0.08

(continues)

TABLE 1	Descriptive Information on Study Constructs (N = 1,186), Continued		
	Mean (*SD*) or %	Skew	Kurtosis
Freshmen spring alcohol consumption (log transformed)	1.51 (1.21)	–0.93	0.08
Sophomore spring alcohol consumption (log transformed)	1.62 (1.13)	–1.03	0.65
Junior spring alcohol consumption (log transformed)	1.75 (1.03)	–1.22	1.52
PCL = The PTSD Checklist.			

23-item self-report items assessing whether and when participants experienced a range of potentially traumatic events (e.g., natural disaster, assault, accidents, illness/injury). This measure also assesses how many times each potentially traumatic event occurred, resulting in a sum of the number of endorsed traumas.

Total posttraumatic stress disorder symptoms (measured in the spin-off survey) Individuals reported on the severity of their posttraumatic stress disorder symptoms in the past 30 days, using the Posttraumatic Stress Disorder Checklist-5 (Weathers et al., 2013). This measure is a 20-item questionnaire, corresponding to the *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition* symptom criteria for posttraumatic stress disorder. The self-report rating scale is 0–4 for each symptom, ranging from "not at all" to "extremely." A total symptom severity score (range: 0–80) can be obtained by summing the scores for each of the 20 items. Cronbach's alpha suggested high internal consistency (.96).

Trauma-related drinking to cope (measured in the spinoff-survey) This scale was created for this study, given that one did not exist in the literature. Using the same response options from the Drinking Motives Questionnaire-Revised (1 = *almost never/never* to 5 = *almost always/always*), frequency of alcohol to cope with symptoms specific to each posttraumatic stress disorder cluster (i.e., reexperiencing, avoidance, negative cognitions and mood, and arousal) was assessed. For example, to assess use of alcohol to cope with reexperiencing symptoms, participants were asked "How often do you consume alcohol to cope with symptoms including repeated, disturbing, unwanted memories, dreams, or feelings about the stressful experience?". Cronbach's alpha was high (.88). The mean was highly skewed (2.84) and kurtotic (9.38). Therefore, a "maximum trauma-related" score was created by using the highest endorsed level of trauma-related drinking to cope for each individual person. This score showed improvement in skew (1.88) and kurtosis (3.10).

Data Analytic Plan

All continuous predictors will be centered before conducting analyses. Longitudinal growth model analyses will be conducted using MPlus Version 8 (Muthen & Muthen, 1998–2017). Analyses will be assessed for goodness of fit using the chi-square goodness-of-fit test statistic, comparative fit index ≥ .95, root mean square error of approximation ≤ .08, and standardized root mean square residual < .08 (Hu & Bentler, 1999). These fit indices are used to determine the objective fit of models estimating no growth, linear, or quadratic growth in alcohol consumption. We initially compared a no growth model with a linear growth model and then compared a quadratic growth model (initially without random effects) with the linear growth model. After determining the most appropriate growth parameter, a model using that growth component (e.g., linear) with one latent profile will be compared with a model with two latent profiles.

In attempting to extract the correct number of latent classes, a solution with two classes will be compared with a solution with three, and three with a solution with four, until adding one additional class does not yield improvement in fit, using the Lo–Mendell–Rubin likelihood ratio test, Bayesian information criterion, and entropy. The Lo–Mendell–Rubin test discerns whether there is significant improvement in fit from adding an additional profile (Mendell et al., 1991). Values close to 1 for entropy indicate good profile separation, with the possible range being 0–1 (Kim et al., 2016). Smaller values on the Bayesian information criterion indicate better fit (Bauer & Curran, 2003; Stull et al., 2011). Solutions in which one or more profiles contain <1% of the sample will not be used. After the most appropriate number of profiles is identified, we will examine differences between profiles on a number of demographics, drinking motives, and trauma-related constructs, using analyses of variance.

RESULTS

Growth Mixture Model
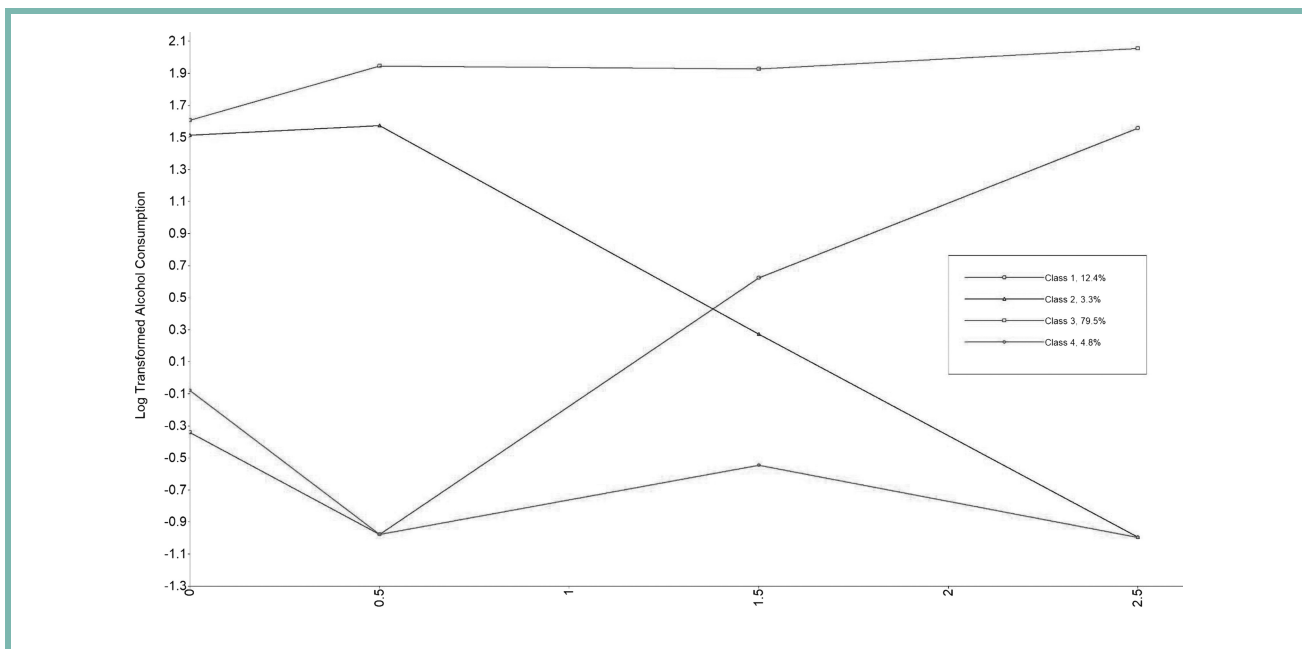
Determining the Appropriate Growth Component No growth ($\chi^2 = 2204.49$, $df = 9$) and linear growth ($\chi^2 = 14.51$, $df = 5$) models with time as the underlying metric were estimated. The difference in χ^2 values exceeded the critical value (18.467) needed for a 4-df difference ($p < .001$). Therefore, we concluded that the linear model fit the data better than the no growth model. Next, we estimated a quadratic model without random effects, to increase the chance that a model including the quadratic growth term would converge. This model ($\chi^2 = 10.59$, $df = 4$) failed to suggest that the quadratic model fit the data better than the linear model (critical value of 10.83 needed for $p < .001$). Therefore, the linear growth model was retained. This model showed good fit to the data: comparative fit index = .99, root mean square error of approximation = .04, and standardized root mean square residual = .03.

Determining the Appropriate Number of Profiles Next, models with an increasing number of profiles were estimated in a stepwise fashion. See Table 2 for a summary of model characteristics. The model specifying two profiles suggested improved fit compared with the model with one profile, as evidenced by a significant Lo–Mendell–Rubin p value ($p < .01$) and a smaller Bayesian information criterion. The model with three profiles showed better fit than the model with two profiles, as suggested by a significant Lo–Mendell–Rubin p value ($p < .01$) and a smaller Bayesian information criterion. A model with four profiles suggested better fit than the model with three profiles, as indicated by a significant Lo–Mendell–Rubin p value ($p < .001$) and a smaller Bayesian information criterion. A model with five profiles did not produce a sensible solution. That is, this model produced an error message suggesting that the results of the Lo–Mendell–Rubin test were not replicated, and thus, the results may not be trustworthy (Feldman et al., 2009). Therefore, a model with four profiles was retained.

A visual depiction of the final retained model including four profiles can be seen in Figure 1. As can be seen, Profile 1, "low increasing," comprising 12.4% of the sample, reported low levels of alcohol consumption at baseline, with consumption significantly increasing over college (intercept: −1.527, $p < .001$; slope: 1.242, $p < .001$). Profile 2, "high decreasing," comprising 3.3% of the sample, reported initially high levels of consumption at baseline and reduced their consumption over college (intercept: 2.147, $p < .001$; slope: −1.274, $p < .001$). Profile 3, "high increasing," comprising 79.5% of the sample, reported initially high levels and increased over the course of college (intercept: 1.828, $p < .001$; slope: 0.098, $p < .001$). Finally, Profile 4, "low decreasing," comprising 4.8% of the sample, began college with low levels and overall reduced their consumption (intercept: −0.813, $p < .001$;

| TABLE 2	Fit Indices and Characteristics of Models With Varying Numbers of Profiles (N = 1,186)			
Number of Profiles	Bayesian Information Criterion	Lo–Mendell–Rubin Value (*p* Value)	Entropy	Smallest Profile Size
1	9080.42	–	–	–
2	8719.03	654.43 ($p < .01$)	.93	8%
3	8533.88	197.10 ($p < .01$)	.89	8%
4	8429.13	120.31 ($p < .001$)	.92	3.3%

Figure 1. Visual depiction of sample means of four profiles. Time is shown on the *x*-axis, with 0 corresponding to fall freshman interview, 0.5 corresponding to spring freshman, 1.5 corresponding to spring sophomore, and 2.5 corresponding to spring junior.

slope: -0.067, $p < .01$). It should be noted that the variance of the intercept and slope factors was significantly different from zero (variance of intercept: 0.316, $p < .001$; slope: 0.037, $p < .01$). A visual depiction of the individual cases' trajectories within each profile is shown in Figure 2.

Differences Between Profiles To determine if the profiles differed on key demographic, drinking motive, and trauma-related variables, differences between these profiles were tested using analyses of variance (see Table 3). In terms of differences

between profiles on race, Whites were more likely to be in the high-increasing profile than the low-increasing and low-decreasing profiles, and Asians were more likely to be in the low-increasing and low-decreasing profiles compared with the high-increasing profile. There were no differences in terms of profile membership for African Americans or those in the other ethnic/racial groups. In terms of cohort effects, those in Cohort 1 were more likely to be in the high-decreasing group, compared with the low-increasing or high-increasing
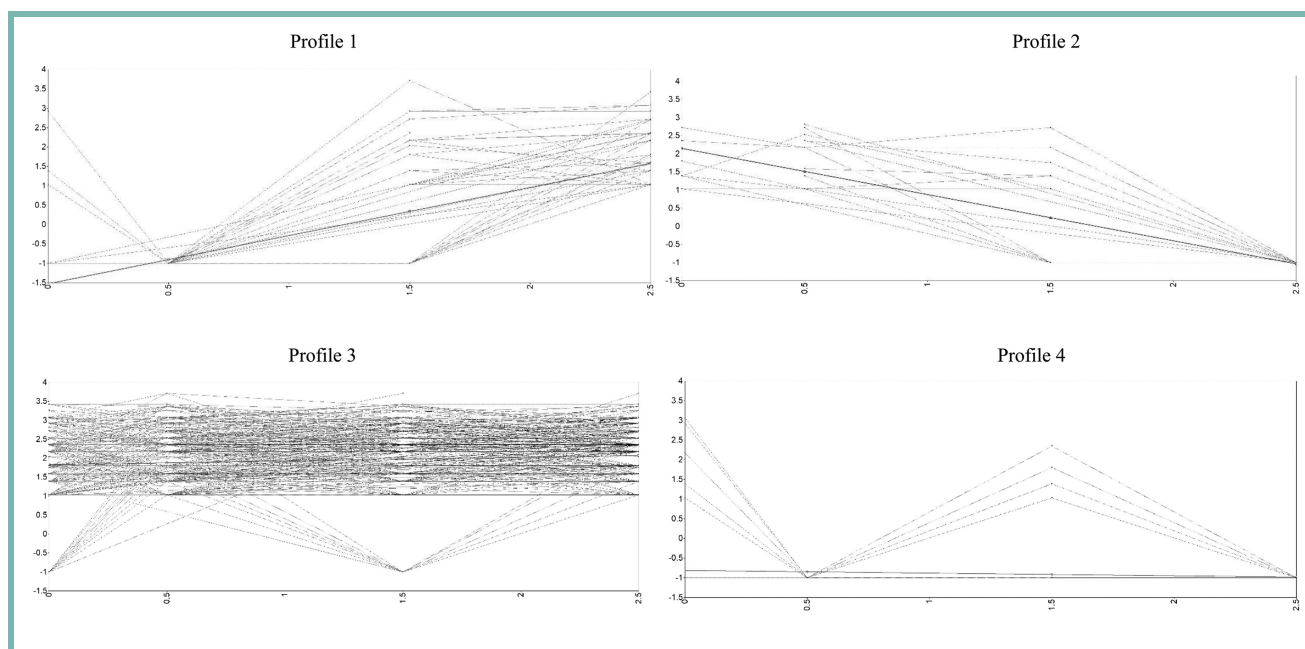
Figure 2. Visual depiction of four profiles.

TABLE 3	Differences on Baseline and Spin-Off Survey Characteristics Based on Mixture Model Profile Assignment (N = 1,186)			
	Profile 1: Low Increasing (*n* = 147)	Profile 2: High Decreasing (*n* = 39)	Profile 3: High Increasing (*n* = 943)	Profile 4: Low Decreasing (*n* = 57)
Baseline constructs				
Gender	76% female	69% female	69% female	77% female
Race				
White	35.3%[a]	44.9%	51.8%[a,b]	33.2%[b]
African American	20.6%	17.2%	20.1%	25.9%
Asian	28.7%[a]	20.7%	14.6%[a,b]	30.6%[b]
Other	15.4%	17.2%	13.5%	10.3%
Cohort				
1	26.5%[a]	48.3%[a,b]	27.1%[b]	28.8%
2	41.9%[a,b]	20.7%[a]	27.8%[b]	30.5%
3	31.6%[a]	31%	45.1%[a]	40.7%
Parent substance use disorder	20.6%[a,b]	37.9%[a,c]	33.2%[b,d]	18.6%[c,d]
Freshmen fall probable posttraumatic stress disorder	31.4%[a]	41.4%[b]	38.1%[c]	9.2%[a,b,c]
Freshmen fall anxiety symptoms	6.72 (3.18)	6.69 (2.65)	6.87 (3.06)	6.74 (3.07)
Freshmen fall depression symptoms	8.27 (3.39)	8.97 (3.90)	8.94 (3.64)	8.50 (3.45)
Freshmen fall drinking motives: conformity	1.42 (0.78)[a]	1.38 (0.66)	1.37 (0.64)[b]	1.18 (0.32)[a,b]
Freshmen fall drinking motives: cope	1.43 (0.79)[a,b]	1.87 (1.06)[a,c]	1.82 (0.96)[b,d]	1.37 (0.75)[c,d]
Freshmen fall drinking motives: enhance	1.98 (0.87)[a,b]	2.62 (1.13)[a,c]	2.90 (0.83)[b,d]	1.78 (1.08)[c,d]
Freshmen fall drinking motives: social	3.24 (0.91)[a]	3.41 (0.91)[b]	3.54 (0.77)[a,c]	2.97 (1.05)[b,c]
Spin-off survey-timed constructs				
Spin-off survey: total number of endorsed traumas	6.63 (7.61)[a]	11.86 (17.72)[a,b]	8.85 (9.23)	6.81 (6.66)[b]
Spin-off survey: drinking to cope	1.46 (0.88)[a]	1.35 (0.71)[c]	1.60 (0.95)[b,c]	1.15 (0.50)[a,b]
Spin-off survey: posttraumatic stress disorder PCL symptoms	13.04 (16.19)	15.25 (22.18)	14.88 (16.30)	13.16 (17.85)

PCL = The PTSD Checklist.
Note. Profiles sharing the same letter are significantly different from one another ($p < .05$).

group. In addition, those in Cohort 2 were more likely to be in the low-increasing group than the high-decreasing or high-increasing group. Finally, those in Cohort 3 were more likely to be in the high-decreasing or high-increasing group, compared with being in the low-increasing or low-decreasing profile.

In addition, those who reported having a parent with a substance use disorder were more likely to be in the high-decreasing or high-increasing group, compared with the low-increasing or low-decreasing profile. Those with higher trauma counts were more likely to be in the high-decreasing group, compared with the low-increasing and low-decreasing groups. Of note, this difference was being driven by one individual in the high-decreasing profile who reported 88 total traumatic events. When this individual was removed from analyses, there were no differences on total traumas between groups. The decision to retain four classes was also replicated when this influential case was removed from analyses.

Individuals with probable posttraumatic stress disorder at baseline were more likely to fall into the low-increasing, high-decreasing, or high-increasing profile, compared with the low-decreasing profile. In terms of drinking motives, those reporting they were more likely to drink alcohol to conform were significantly more likely to fall into the low-increasing and high-increasing profiles, compared with the low-decreasing group. Those who endorsed more use of alcohol to cope with broad distress, for enhancement, or to be social were more likely to be in the high-decreasing and high-increasing profiles, compared with the low-increasing or low-decreasing profile. Finally, those who endorsed more use of alcohol to cope with

trauma-related distress in the spin-off survey were more likely to fall into the high-increasing and low-increasing profiles, compared with the high-decreasing and low-decreasing profiles. There were no differences between profiles on gender, baseline anxiety and depressive symptoms, or posttraumatic stress disorder symptoms using the Posttraumatic Stress Disorder Checklist as reported in the spin-off survey.

DISCUSSION

The college period is a sensitive developmental period associated with an increased risk for problematic alcohol use, particularly among those who experience trauma (Ullman et al., 2005). However, there is also significant variability in the extent to which individuals change in their alcohol use over the course of college (Brunborg et al., 2017; Maggs & Schulenberg, 2004). To our knowledge, no studies have extracted latent profiles of alcohol consumption among a sample of trauma-exposed college students. In addition, no studies of trauma-exposed college students have examined the associations between latent profiles based on alcohol consumption and demographic, drinking motives, and trauma-related constructs.

Latent Profiles of Alcohol Consumption Among Those With Trauma

The current study found support for four profiles of individuals based on linear change in alcohol consumption. These profiles were composed of individuals who began college drinking low amounts of alcohol and increasing over time, those who began college at high levels of alcohol consumption and decreasing over time, those who began college at high levels and increased, and those who began college drinking low amounts and decreased. As no prior studies had included trauma-exposed college students, it is difficult to compare these findings with those of prior work. However, the prior studies examining alcohol trajectories closest in the developmental age (e.g., 18–26 and 12–23 years) to those in the current study had found that, during this 18- to 22-year age range, there are alcohol groups that show stably high, medium, and low levels of alcohol use (Casswell et al., 2002) or initially increasing and then decreasing trends in alcohol use (Chassin et al., 2002). Thus, the current study is the first to our knowledge to find that, among trauma-exposed college students, individuals tend to change linearly in their alcohol use during college and that there is evidence for initially low decreasing, initially low increasing, initially high decreasing, and initially high increase profiles.

Associations Between Profile Membership and Constructs of Interest

The current study also tested associations between profile membership and trauma-related variables, motives to use alcohol, and demographic variables. Surprisingly, individuals who experienced more lifetime traumas were more likely to fall in the high-decreasing profile, compared with all other profiles. It is important to again note, however, that this difference was being driven by one individual in the high-decreasing profile reporting an extremely high number of total traumas. Thus, one should exercise caution when interpreting this finding. In contrast, those with posttraumatic stress disorder were more likely to find themselves in profiles identified by high initial alcohol use and/or increasing alcohol use over the course of college. These findings suggest that trauma exposure and probable posttraumatic stress disorder are broadly associated with higher levels of alcohol use, consistent with the self-medication model (Khantzian, 1990; Langdon et al., 2017). However, there is some heterogeneity in findings such that both number of traumas and posttraumatic stress disorder predict higher levels of initial use, but only probable posttraumatic stress disorder predicts increases in alcohol use during college. In contrast, individuals who report more traumas tend to decrease in their consumption over the course of college. Additional work is needed to replicate and extend these findings.

This study is the first to examine associations between latent profiles of alcohol consumption and drinking motives, finding that individuals who reported more use of alcohol to conform tended to find themselves in the profiles involving increasing alcohol use. Interestingly, those who reported more use of alcohol to be social, for enhancement, or to cope broadly with distress tended to be in profiles characterized by high initial levels of alcohol use. These trends together suggest that use of alcohol to cope, be social, and complete difficult tasks may be associated with a greater initial risk for alcohol use. However, during college, use of alcohol to conform with peers is driving increases in alcohol use. These findings are consistent with prior work finding that the association between conformity motives and alcohol misuse is weakest among college freshmen, compared with upper classmen. However, this body of work finds that social, enhancement, and coping motives show similar, stronger associations with alcohol misuse at the beginning of college (Martens et al., 2008). It may be that, over the course of college, as individuals' friends become the more central social and support systems, the pressure to "fit in" in terms of alcohol use becomes the more central driving factor for alcohol use.

Those who reported that they were more likely to use alcohol to cope with trauma-related distress were more likely to be in groups that increased over time. This finding suggests that drinking to cope with trauma-related distress may be influential in driving changes in alcohol use over college among those with trauma exposure. However, it should be noted that drinking to cope with trauma-related distress was assessed toward the end of college, whereas the other drinking motive questions were assessed at the beginning of college. Therefore, it is less clear how drinking to cope with trauma-related distress at the beginning of college may impact alcohol use trajectories.

Those with parents with a substance use disorder were more likely to comprise profiles characterized by high, increasing levels of alcohol consumption. This finding is consistent with prior work finding that offspring of parents with substance misuse tend to show higher levels of alcohol use

as well as steeper increases in alcohol use (Chassin et al., 1996). Whites were more likely to be in the high-increasing profile, and Asians were more likely to be in the profiles characterized by low initial levels. These findings are consistent with prior research suggesting that Whites tend to report higher, and Asians tend to report lower, levels of problematic alcohol use (Chen & Jacobson, 2012). Finally, we broadly found evidence that Cohorts 2 and 3 were more likely to be in cohorts that increased over the course of college, and Cohort 1 was overrepresented in the group that began high but decreased over college. These findings are consistent with the research finding that the prevalence of alcohol use, as well as volume and frequency of alcohol use, has been increasing between 2001–2002 and 2012–2013 (Dawson et al., 2004), highlighting the continued need for improved prevention efforts.

LIMITATIONS, IMPLICATIONS, AND CONCLUSIONS

This study has limitations that should be acknowledged. First, we are unable to discern the direction of effects between group membership and the demographic and trauma-related constructs examined. For example, it may be that individuals in the high-increasing group are more likely to meet criteria for probable posttraumatic stress disorder because they use alcohol to alleviate emotional distress from trauma-related symptoms. Alternatively, it could be that those consuming more alcohol as adolescents are more likely to engage in behaviors that increase the likelihood of trauma and subsequent distress. In addition, our measure of probable posttraumatic stress disorder was not precise and likely resulted in a number of individuals who do not have posttraumatic stress disorder being given a positive value for probable posttraumatic stress disorder.

Despite limitations, the current study adds to prior work by finding that, among those who are trauma exposed, four profiles of individuals were extracted based on alcohol use. A substantial portion of these college students in this sample began college with low levels of alcohol consumption and increased over college, which had not been found in mixture models. This study also found significant associations between several included constructs and group membership, pointing to a number of factors that are associated with risky patterns of alcohol use. These findings provide a focus for future research examining how such associations may unfold in a longitudinal framework.

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Kaitlin E. Bountress ORCID ID:
https://orcid.org/0000-0001-7817-8341

Sage E. Hawn ORCID ID:
https://orcid.org/0000-0001-8501-4169

Danielle M. Dick ORCID ID:
https://orcid.org/0000-0002-1636-893X

Ananda B. Amstadter ORCID ID:
https://orcid.org/0000-0001-6285-9943

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