Alcohol-Induced Blackouts and Other Negative Outcomes During the Transition Out of College

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ABSTRACT. Objective: There is considerable debate about the prospective association between alcohol-dependence symptoms and alcohol-related blackouts. The goal of this study was to examine the associations among alcohol-dependence symptoms, blackouts, and social and emotional consequences during the transition out of college. **Method:** Participants (N = 829; 66% female) were part of a 6-year longitudinal study designed to explore alcohol use and risky behaviors during and after college. Data for these analyses were from Years 4 and 5 of data collection, which most closely corresponded to the transition out of college. Using cross-lagged models, we tested the prospective associations of alcohol-dependence symptoms, blackout frequency, and social and emotional consequences. **Results:** Alcohol-dependence symptoms in Year 4 predicted increased frequency of blackouts and social and emotional consequences during the subsequent year. Blackouts during Year 4 also significantly predicted increased alcohol-related social and emotional consequences, but not dependence symptoms, in Year 5. **Conclusions:** Although blackouts do not predict the development of alcohol-dependence symptoms, they increase the risk for less severe alcohol-related consequences during the transition out of college. This may result from the cognitive reconciliation of negative behaviors that occur during these episodes of amnesia. (*J. Stud. Alcohol Drugs, 76,* 516–524, 2015)

ALCOHOL-INDUCED BLACKOUTS are episodes of anterograde amnesia whereby individuals have difficulty recalling entire events or portions of events that occurred while they were intoxicated (White, 2003). In earlier studies—for example, by Jellinek (1952), Goodwin (1969), and others (e.g., Curlee, 1973; Tarter & Schneider, 1976)—blackouts were exclusively associated with alcoholism. More recent research, however (e.g., Anthenelli et al., 1994; Hartzler & Fromme, 2003; LaBrie et al., 2011; Wetherill & Fromme, 2011; White et al., 2002), has established the experience of blackouts among healthy, young adult drinkers. After more than 40 years of research, however, we still know little about the phenomenology, causes, or consequences of blackouts. The current study is focused on the prognostic significance and specific consequences that are associated with alcohol-induced blackouts.

Whereas someone in a blackout is aware of their behavior in the moment, alcohol impairs the transfer of information from short-term to long-term memories, thereby impairing later recall of the event (White, 2003). Thus, someone in a blackout is fully conscious and able to actively engage in various activities, which include conversations, driving vehicles, and sexual behavior, but may not remember them later. The inability to recall one's behaviors denotes an important distinction between two types of blackouts. Fragmentary blackouts are episodes of amnesia that can later be recalled after receiving cues, whereas en bloc blackouts are forgotten memories that cannot be evoked even after receiving prompts or reminders (Hartzler & Fromme, 2003; Jennison & Johnson, 1994).

Although blackouts can only occur as a result of heavy drinking, a key question is whether blackouts are simply a consequence of problematic drinking behavior or if they engender greater risk for future problems, beyond just excessive alcohol consumption. Similar risk factors, including early-onset drinking (Gruber et al., 1996; Jennison & Johnson, 1994; White et al., 2002) and family history of alcoholism (Jennison & Johnson, 1994; LaBrie et al., 2011; Marino & Fromme, 2015) are associated with both blackouts and alcohol use disorders (AUDs), suggesting a possible shared biological predisposition. Further, only 50% of drinkers experience blackouts, with these individuals showing greater memory deficits while intoxicated than those who do not experience blackouts (Hartzler & Fromme, 2003; Wetherill & Fromme, 2011; Wetherill et al., 2012, 2013). Consequently, blackouts may be indicative of a genetic vulnerability to other alcohol-related problems. In addition, being unable to remember events while drinking provides opportunities for individuals to engage in potentially atypical behaviors that can have negative social and emotional consequences. Therefore, further research is needed to determine prospective associations among alcohol-induced blackouts, heavy drinking, and various negative outcomes.

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Blackouts and alcohol dependence

Early research among samples of alcoholics indicated that between 64% and 94% endorsed alcohol-induced blackouts, and thus blackouts were considered to be an important factor associated with alcoholism (Curlee, 1973; Goodwin, 1969; Tarter & Schneider, 1976). Although there was agreement about the comorbidity between blackouts and alcoholism, there was debate about whether blackouts preceded or were a symptom of alcoholism. More specifically, Jellinek (1952) proposed that blackouts preceded other phases of alcoholism (i.e., loss of control, "benders"), suggesting that blackouts were prodromal indicators of AUDs. Subsequent research, however, indicated that blackouts were associated with heavy drinking and problematic alcohol use but were not considered a strong predictor, beyond consumption patterns, for AUDs (Anthenelli et al., 1994). Instead, blackouts might be viewed as a symptom of alcohol dependence, especially among alcoholics (Goodwin, 1969).

More recent studies have shown that blackouts occur at varying levels of blood alcohol concentrations (BACs) and among social drinking populations. In fact, alcohol-induced blackouts have been reported by roughly half of college drinkers (White et al., 2002) and are commonly seen with a quick rise in BAC as the result of rapid, excessive intake of alcohol (Perry et al., 2006; Ryback, 1970). Indeed, studies have repeatedly shown that blackouts are a consequence of heavy drinking in college students (Barnett et al., 2014; Read et al., 2008). The discovery of blackouts in large portions of college drinkers, most of whom will never develop an AUD, provides evidence that blackouts may not be prophetic of the development of alcoholism, but instead a consequence of heavy drinking.

Conversely, a few longitudinal studies have shown that experiencing blackouts predicts future alcohol-dependence symptoms and other severe consequences in nonalcoholic samples. Two prospective studies found that those who reported blackouts at baseline were more likely to have a higher total number of alcohol-dependence symptoms, including loss of control over their drinking, tolerance symptoms, and missed work or school at future assessments (Anthenelli et al., 1994; Jennison & Johnson, 1994). It is important to note, however, that when the quantity and frequency of alcohol consumption were taken into account in a sample of male participants, blackouts were no longer strong predictors of AUDs, indicating that the pattern of drinking, rather than blackouts alone, may predict dependence symptoms (Anthenelli et al., 1994). Another study showed that having blackouts predicted greater likelihood of alcohol-related injuries 2 years later, indicating that blackouts conferred additional risk for other serious, persistent consequences (Mundt et al., 2012). Consequently, blackouts may be conceptualized as both a consequence of heavy drinking as well as a predictor of future alcohol-dependence symptoms and other alcohol-related problems.

This prior research should, however, be interpreted in light of some limitations. For example, one study assessed blackouts by asking about episodes of amnesia when memories were not later recovered, which accounts for only en bloc blackouts (Jennison & Johnson, 1994), whereas another study used an item that asked participants how many times they "suddenly found themselves in a place that they could not remember getting to," which does not effectively capture all instances of memory impairment related to drinking (Mundt et al., 2012). Another important limitation of previous studies is that the analyses did not account for the stability of variables across time and the associations among variables at each time point. Further, none of the previous studies concentrated exclusively on the transition out of college, which is an important developmental period that often entails a change in drinking patterns. Therefore, further research is needed to more thoroughly determine if blackouts confer additional risk for future alcohol dependence beyond a pattern of heavy drinking.

In an effort to reconcile conflicting research on the association between blackouts and negative alcohol-related outcomes, we aimed to provide a prospective test of these associations among a sample of healthy, young adult drinkers. Although alcohol dependence is one negative outcome of heavy alcohol use, other less severe consequences may also be related to blackouts and cause significant distress for the individual (White et al., 2004). Thus, we endeavored to determine the distinct associations between blackouts and different types of negative outcomes.

Blackouts and social and emotional consequences

Social and emotional consequences are examples of a particular subset of less severe blackout-related negative outcomes. For instance, college students who experienced blackouts were more likely to report emotional stress (Buelow & Koeppel, 1995) and fear (White et al., 2004), and those who reported three or more blackouts were more likely to have others voice concern about their drinking (White et al., 2002) than those who did not report blackouts. It is noteworthy that previous research has investigated very specific social and emotional consequences (e.g., concern from friends or family), which may be endorsed by a small minority of individuals. Allowing for the assessment of more general social and emotional consequences could capture a higher, more representative endorsement of different types of such consequences. Consequently, the current study was designed to further examine whether those who experience blackouts are also at an increased risk for experiencing more social and emotional consequences from their alcohol-related behavior, assessed using a broad conceptualization of these consequences.

Comparing the associations between blackouts and social and emotional consequences, as well as alcohol-dependence symptoms, allows for a finer grained analysis of whether blackouts confer an overall risk for future problems or if they bestow differential risk based on the severity and type of negative outcome.

Overview of the current study

Key questions include whether blackouts (a) are simply a consequence of heavy patterns of drinking, (b) are prognostic indicators of the development of alcohol dependence (as suggested by Jellinek), or (c) contribute to other negative alcohol-related outcomes above and beyond heavy drinking patterns. In an effort to improve on previous research, we used a general assessment of blackouts to capture both fragmentary and en bloc blackouts. Our first aim was to examine the prospective influence of alcohol-dependence symptoms and heavy drinking on blackouts. Our second aim was to assess the longitudinal effects of blackouts on subsequent negative outcomes, specifically alcohol-dependence symptoms and social and emotional consequences. We analyzed data from a longitudinal study that spans the transition out of college, which is an important developmental period that has received relatively little attention in the literature. Whereas considerable research has focused on the transition into college (e.g., Abar & Maggs, 2010; Fromme et al., 2008; Read et al., 2002; White et al., 2006), an equally important transition occurs as students complete their college experience. Such research would help identify factors that may influence continued problem behaviors and drinking consequences that occur after this transition. Using cross-lagged analyses, we controlled for the stability of all variables across time when testing prospective associations. We hypothesized that reporting heavier drinking and more alcohol-dependence symptoms during the last year of college would be prospectively and positively related to blackouts in the following year. We also predicted that the experience of blackouts in Year 4 would be associated with social and emotional consequences in Year 5. Because blackouts are contingent on high quantities of alcohol consumption during a drinking episode (Jennison & Johnson, 1994; Labrie et al., 2011; White, 2003), we controlled for typical drinking quantity in an effort to target the effect of blackouts on future outcomes, independent of heavy drinking.

Method

Participants

Participants were members of a cohort of students who accepted admission into a large southwestern university in 2004. They were recruited as a part of a longitudinal study designed to measure alcohol use and other risky behaviors during the transition into and out of college. First-time students between ages 17 and 19 years (N = 6,391) were recruited during the summer before their matriculation into the university. Of invited students, 76% agreed to participate and met the additional eligibility requirement of being unmarried (n = 4,832). Of these individuals, 3,046 were randomized into a longitudinal arm of the study. Those who provided consent and completed the high school survey (n = 2,245) comprised the longitudinal sample. Longitudinal participants were asked to complete online surveys about their senior year in high school and then again at the end of their fall and spring semesters of college in Years 1–3 and at the end of November (which corresponded to the fall semester assessments) in Years 4–6.

To target individuals during the start of the transition out of college, we only included participants who completed the Year 4 and Year 5 surveys (n = 1,245). In addition, because blackouts require the consumption of alcohol, we further restricted the sample to include only those students who endorsed consuming alcohol at least once during a typical week during the past 3 months at Year 4 (n = 829). The final sample had a mean age of 21.8 years (SD = 0.3) at Year 4, was 66% female, 60% White, 16% Asian, 13% Hispanic, 2% African American, and 9% other racial background. This racial/ethnic distribution was comparable to the overall university population. For a more detailed description of participant recruitment, see Hatzenbuehler et al. (2008).

Measures

Demographics. Participants reported on demographics at both assessments, which included gender and age. We used gender from Year 4 in our analyses.

Quantity of alcohol use. One question from the Daily Drinking Questionnaire (Collins et al., 1985) assessed the typical quantity of alcohol use during the past 3 months. The question used an open-ended format for participants to provide the typical number of drinks consumed on each drinking day for a typical week. The average number of beverages consumed on a drinking day was used for these analyses. This quantity variable was based on "standard drinks," with one standard drink equal to 1.5 fluid oz. of distilled spirits, 5 fluid oz. of wine, or 12 fluid oz. of beer.

Alcohol-induced blackouts. A single item asked about how often the participant "had difficulty remembering things you said or did or events that happened while you were drinking" during the past 3 months. This item allowed for the assessment of both fragmentary and en bloc blackouts, as the item did not stipulate subsequent recall. A 5-point Likert response scale was used (1 = *never,* 2 = *some of the time,* 3 = *half of the time,* 4 = *most of the time,* and 5 = *always*).

Alcohol dependence. The 23-item Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989) was completed for the prior 3 months, but, to be consistent with

our study hypotheses, current analyses included only the 12-item abuse/dependence factor (Martens et al., 2007). Sample items included, "Kept drinking when you promised yourself not to," "Tried to cut down or quit drinking," and "Felt you were going crazy." The frequency of alcohol-dependence symptoms was coded on a 0–4 scale (0 = *0,* 1 = *1–2,* 2 = *3–5,* 3 = *6–10,* 4 = *>10*) but was dichotomized such that endorsing any abuse/dependence items was coded as 1, whereas denying items was coded as 0 (Martens et al., 2007). All items were summed for the final score, which demonstrated good internal reliability across both years (α = .82 and .83).

Social and emotional consequences. To capture a variety of possible experiences, two questions were used to assess how often participants experienced any social (e.g., felt rejected or hurt your reputation) or emotional (e.g., had regrets, felt angry, or felt worried) consequences as a result of their alcohol use over the previous 3 months (Stappenbeck & Fromme, 2010). A Likert response scale ranged from 0 = *never* to 5 = *always.* These two items were averaged to create composite Social and Emotional Consequences scores for Years 4 and 5. This variable demonstrated good internal reliability across both years (α = .80 and .78).

Procedure

Using a secure Web server (DatStat; Seattle, WA), participants completed surveys about their alcohol use and related outcomes for the prior 3 months at each assessment. The analyses for this study are based on Years 4 and 5 surveys only, which generally corresponded with the fourth year of college and the year after college. Participants were compensated $40 for completion of each survey.

Data analytic plan

We ran preliminary analyses to assess differences in demographic variables attributable to attrition of participants, gender differences in the study variables, and the stability of study variables across the two assessments. For our main study hypotheses, we used autoregressive, cross-lagged analyses in Mplus Version 7 (Muthén & Muthén, 1998–2011), which tested the longitudinal effects of alcohol-dependence symptoms and blackouts on future outcomes, after accounting for the stability among variables across the two assessment periods (i.e., Years 4 and 5). Our model allowed us to test whether alcohol-dependence symptoms in Year 4 predicted an increased frequency of blackouts during Year 5 and if blackouts were associated with future negative outcomes, controlling for drinking quantity across the two assessments. Cross-lagged models control for the association among study variables at each time point, which means that all cross-lagged associations provide a clear association among targeted variables independent of the association among other variables during the same period. To assess the desired associations, a single model was run that included drinking quantity, blackout frequency, alcohol-dependence symptoms, and social and emotional consequences. Gender differences in some study variables existed, so the model used gender as a covariate. These analyses also allowed us to test the predictive effect of alcohol quantity on dependence symptoms, social and emotional consequences, and blackouts.

We used several indices to assess model fit, specifically the chi-square goodness-of-fit test, Tucker–Lewis index (TLI), comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean residual (SRMR). For these indices, values greater than .95 for the TLI and CFI, less than .05 for the RMSEA, and less than .05 for the SRMR designate good model fit (Kline, 2011). Missing data were addressed by the full-information maximum likelihood estimation in Mplus, which can handle nonsystematic missing data.

The RAPI abuse/dependence score was positively skewed for both Years 4 and 5 (i.e., skewness ≥ 2) and had a large proportion of zero scores (i.e., kurtosis ≥ 10). As a result, the RAPI scores were log-transformed to correct for the zero-inflated and positively skewed data. The log transformations corrected for the skewness of the RAPI abuse/dependence score (i.e., skewness ≤ 2). No other study variables showed excessive skewness and therefore were not log-transformed.

Results

Participants who completed data collection at Years 4 and 5 and did not abstain from drinking during Year 4 (n = 829) were compared with all participants who were not included in analyses (n = 1,416) on descriptive variables. Drinkers who were included in the current analyses were more likely to be White, $\chi^2(7) = 24.71$, $p < .001$, less likely to be African American, $\chi^2(7) = 10.75$, $p < .01$, and had a higher proportion of women, $\chi^2(1) = 18.16$, $p < .001$, than those who were excluded from analyses.

Bivariate correlations among study variables

The cross-sectional relations between the study variables are shown in Table 1. Blackout frequency and alcohol dependence were significantly correlated at both Year 4 and Year 5 (rs = .42 and .37, respectively, ps < .001). In addition, social and emotional consequences were significantly correlated with alcohol dependence (rs = .56 and .58, respectively, ps < .001), indicating some overlap between these measures. Finally, male gender correlated positively with quantity of drinking (rs = .16 and .16, ps < .001) and alcohol dependence (rs = .07 and .08, ps < .05) in Years 4 and 5, respectively, whereas it was unrelated to the other study variables.

Table 1. Bivariate correlations among study variables

Variable	1.	2.	3.	4.	5.
1. Male gender	–	-.02	.16***	.07*	-.05
2. Blackout frequency	.01	–	.39***	.42***	.42***
3. Alcohol quantity	.16***	.37***	–	.22***	.19***
4. RAPI dependence	.08*	.37***	.27***	–	.56***
5. Social and emotional consequences	-.00	.41***	.25***	.58***	–

Notes: Correlations for Year 4 study variables are above the diagonal, and correlations for Year 5 study variables are below the diagonal. RAPI = Rutgers Alcohol Problem Index.
*$p < .05$; ***$p < .001$.

Study variables across Years 4 and 5 and by gender

Fifty-three percent of study participants reported blackouts during Year 4 (67% female; 33% male), and 47% reported blackouts in Year 5 (64% female; 36% male). As shown in Table 2, there was a reduction in the quantity of drinking as well as a slight decline in the frequency of experiencing blackouts from Year 4 to Year 5. Participants also showed a decrease in alcohol dependence and social and emotional consequences over this period.

Table 3 depicts the gender similarities and differences across the two assessments. Men reported consuming more alcohol on drinking days than women in both Years 4 and 5, and more alcohol-dependence symptoms in Years 4 and 5. The effects for gender differences in alcohol-dependence symptoms were relatively small, but we used gender as a covariate in our model. In addition, there were no gender differences in frequency of blackouts or social and emotional consequences. The effect sizes show the strength of the gender differences among the variables at Years 4 and 5 separately.

Alcohol-dependence symptoms, blackouts, and social and emotional consequences

The model was a just-identified model and thus fit the data well, $\chi^2(36) = 2{,}061$, $p < .001$, CFI = 1.00, TLI = 1.00, RMSEA = .00, and SRMR = .00. The paths of the model are depicted in Figure 1 with standardized coefficients for all paths. The autoregressive paths were all significant (ranging from .27 to .49), which indicates that the study variables were moderately stable across time. There were several significant cross-lagged paths. Alcohol-dependence symptoms (coefficient = .09, $p < .05$) and alcohol quantity (coefficient = .16, $p < .001$) at Year 4 predicted blackouts at Year 5. Alcohol-dependence symptoms in Year 4 also predicted social and emotional consequences in Year 5 (coefficient = .17, $p < .001$). Year 4 blackouts did not predict Year 5 alcohol-dependence symptoms (coefficient = .07, $p = .07$) but did predict Year 5 social and emotional consequences (coefficient = .09, $p < .05$) and quantity of alcohol consumed (coefficient = .07, $p < .05$).

Discussion

This study aimed to determine the prospective associations among alcohol-dependence symptoms, blackouts, and future alcohol-related negative outcomes above and beyond the quantity of alcohol consumed during the transition out of college. Using prospective cross-lagged models that spanned 1 year, our results indicate that blackouts are a consequence of alcohol-dependence symptoms rather than an indicator of future alcohol dependence, which provides further clarification on the debate about the association between blackouts and AUDs. In addition, our analyses provide support for blackouts as a risk factor for alcohol-related social and emotional consequences beyond simply the quantity of alcohol consumed.

Blackouts and alcohol-dependence symptoms

Consistent with prior research (Anthenelli et al., 1994), and using robust statistical models in a large, ethnically diverse college sample, our findings show that blackouts do not predict the development of alcohol-dependence symptoms 1 year later. Instead, alcohol-dependence symptoms predict the experience of blackouts, even when the stability of blackouts across time is controlled for. These findings

Table 2. Summary statistics for Years 4 and 5

Variable	Possible range	Year 4 *M* (*SD*)	Year 5 *M* (*SD*)	*d*
Alcohol quantity	1–17	3.16 (2.24)	2.49 (2.03)	0.31***
Blackout frequency	1–5	1.67 (0.76)	1.60 (0.76)	0.09*
RAPI dependence	0–12	0.91 (1.68)	0.69 (1.55)	0.14***
Social and emotional consequences	0–4	0.50 (0.70)	0.40 (0.64)	0.15***

Note: RAPI = Rutgers Alcohol Problem Index.
*$p < .05$; ***$p < .001$.

Table 3. Gender means for study variables

Variable	Year 4 Men *M* (*SD*)	Year 4 Women *M* (*SD*)	Year 5 Men *M* (*SD*)	Year 5 Women *M* (*SD*)	$d_{Year\ 4}$	$d_{Year\ 5}$
Blackout frequency	1.65 (0.75)	1.68 (0.76)	1.60 (0.70)	1.60 (0.79)	-0.04	0.00
Alcohol quantity	3.65 (2.67)	2.90 (1.93)	2.92 (2.43)	2.26 (1.74)	0.32***	0.31***
RAPI dependence	1.07 (1.86)	0.83 (1.57)	0.89 (1.91)	0.58 (1.32)	0.14*	0.19**
Social and emotional consequences	0.45 (0.64)	0.52 (0.73)	0.39 (0.64)	0.40 (0.64)	-0.10	-0.02

Notes: Effect sizes for gender differences in Year 4 and Year 5 are shown in the last two columns. RAPI = Rutgers Alcohol Problem Index.
*$p < .05$; **$p < .01$; ***$p < .001$.

are consistent with the idea that a pattern of problematic drinking increases the likelihood of having alcohol-induced blackouts, as suggested by earlier studies of blackouts among alcoholics (Goodwin et al., 1969). Contrary to earlier beliefs (Jellinek, 1952), our results do not indicate that blackouts are a precursor to alcohol-dependence symptoms but rather are a consequence of dependence-like drinking. Although our study did not include clinical diagnoses, the RAPI abuse/dependence scale provides an assessment of alcohol withdrawal and tolerance symptoms (e.g., "Felt physically or physiologically dependent on alcohol"), which may serve as a proxy for alcohol dependence. Therefore, endorsing higher scores on the abuse/dependence factor of the RAPI during senior year of college signifies that these participants are engaging in more problematic alcohol consumption, and as a result, are more likely to experience continued negative consequences, including blackouts, as they transition out of college.

Given a genetic vulnerability to alcohol dependence (e.g., Frank et al., 2012; Iyer-Eimerbrink, 2014; Kendler et al., 1992; Li et al., 2014) and our analyses, which indicate that greater alcohol-dependence symptoms are associated with

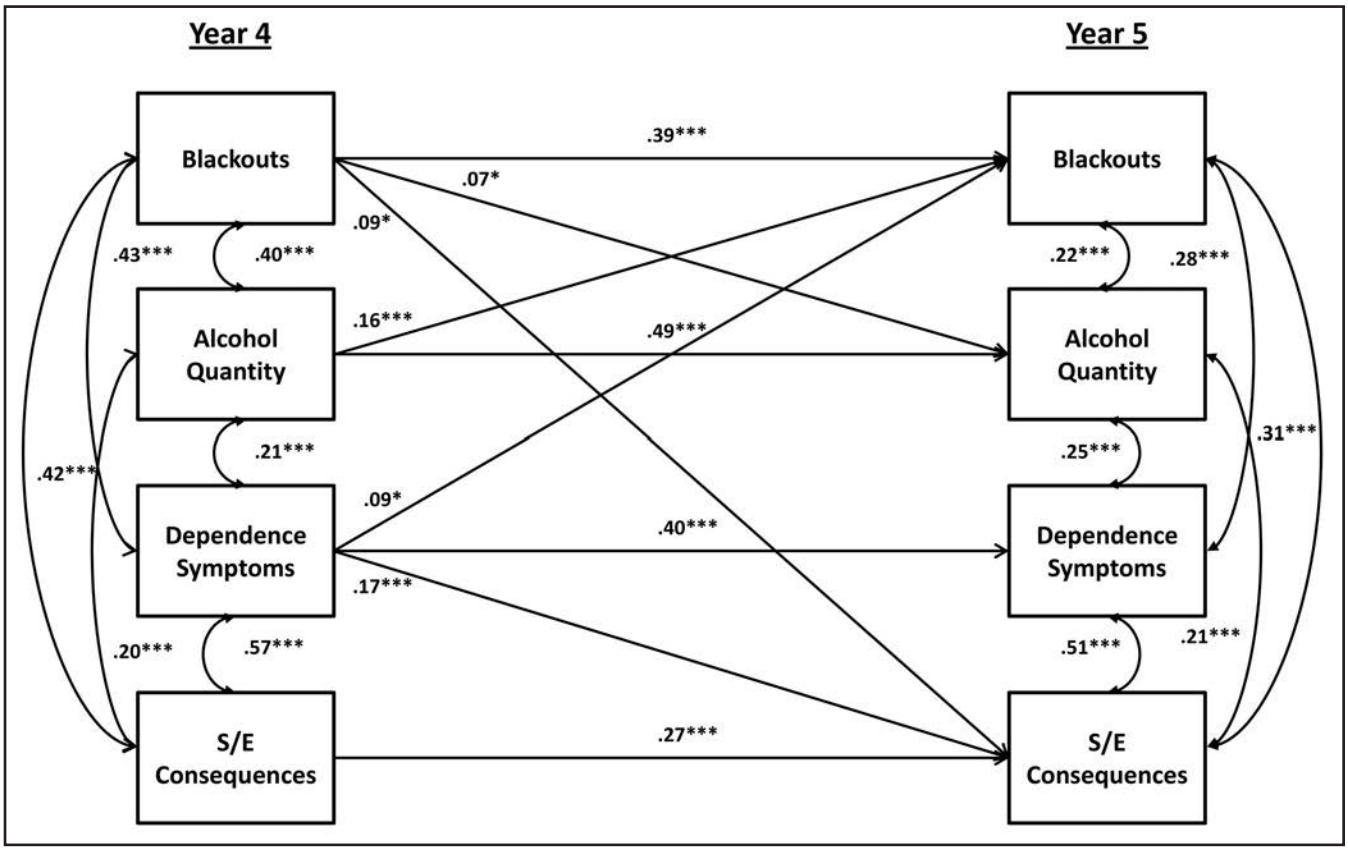

Figure 1. Cross-lagged model of alcohol-related blackouts and negative outcomes. Values are standardized path coefficients for Years 4 and 5. Only significant paths are shown in the model. S/E = social and emotional consequences.
*$p < .05$; ***$p < .001$.

more frequent blackouts, it is possible that blackouts and alcohol dependence share a similar genetic susceptibility. In fact, previous research has shown that family history of alcohol dependence is associated with blackouts (Jennison & Johnson, 1994; LaBrie et al., 2011; Marino & Fromme, 2015). Future research might better characterize these associations between alcohol dependence and blackouts by examining genetic profiles that may underlie a vulnerability to both.

Blackouts and other consequences

Although we did not find that blackouts are indicative of future alcohol dependence, our analyses provide evidence that blackouts confer additional risk for social and emotional consequences beyond the quantity of alcohol consumed. Whereas our analyses cannot provide information about the co-occurrence of blackouts and social and emotional consequences, our results do show that blackouts and social and emotional consequences are correlated in both Years 4 and 5 and that these variables remain relatively stable across the 2 years. Taken together, these results are indicative of a pattern across time. One reason blackouts may be associated with future negative consequences is that they distort the memories of events that occur while consuming alcohol. These events may involve unplanned and perhaps aberrant behaviors, which can contribute to sustained social consequences from peers. Individuals must also reconcile their intoxicated, blackout-related behavior with their own sober values. If their blackout-related behavior is divergent from their personal values and typical behavior, dissonance may contribute to negative emotional reactions that remain across time. Based on our findings, those who experience blackouts in their fourth year of college are likely to continue having blackouts the following year and are more likely to experience emotional and social consequences that may be associated with uncharacteristic blackout-related behavior, both current and past.

People may be more prone to engaging in dangerous or negative behavior while in a blackout because of contextual memory deficits (Wetherill & Fromme, 2011). The portion of drinkers who experience blackouts have greater difficulty recalling things like where they were or who they were with while they were intoxicated. Consequently, they may be less aware of specific contextual factors in their environment while they are drinking and therefore engage more freely in behavior that could cause negative consequences in the aftermath of their drinking. For example, if an intoxicated individual is less aware of the people who are in their presence, they may be more likely to say something rude or hurtful that could cause social and emotional repercussions. Combined with our results, the evidence for contextual memory deficits suggests that the biologically based memory and brain differences that exist for people who are prone to blackouts put them at greater risk for future consequences, even when controlling for their heavy drinking patterns.

Transition out of college and intervention implications

Beyond the effects of blackouts on future negative outcomes, our analyses are some of the first to examine the association between alcohol use and related consequences during the transition out of college. As expected, drinking quantity, dependence symptoms, social and emotional consequences, and blackouts all decreased over the two assessment periods. These decreases in alcohol-related behavior are consistent with maturing out of heavy college drinking patterns into more adult roles and less alcohol consumption (e.g., Chen & Kandel, 1995; Donovan et al., 1983; Jochman & Fromme, 2010; Littlefield et al., 2009). Yet, students who reported blackouts and alcohol-dependence symptoms during the fourth year of college continued to experience blackouts and have social and emotional consequences of drinking during the following year. Thus, although the students as a whole began to decrease their problematic alcohol use as they left college, those who are engaging in more troublesome behaviors near the end of college continue to have more problems as the transition out of college progresses. This speaks to the importance of interventions that target students during their last year of college.

Interventions like AlcoholEdu (Wall, 2007) and E-Chug (Walters et al., 2007), which typically target students as they transition into college, might also be implemented for students during their final semester of college. These interventions could consist of similar content as the modules given during the start of college but provide normative feedback based on postcollege drinkers. College students are accustomed to the drinking norms of their college peers but may be less familiar with the drinking patterns of young adults in the working world. Thus, providing normative information during the last semester of college could precipitate a steeper decline in problematic alcohol use during this important transitional period.

Our findings also provide further intervention implications in terms of blackouts as a risk factor for future alcohol-related consequences. Providing more education about the causes and consequences of blackouts could enhance alcohol prevention programs. Targeted interventions might also focus on individuals who report previous blackouts, as they are at greater risk for certain future alcohol-related negative outcomes. One way to potentially decrease blackouts and their related consequences would be to emphasize the use of protective behavioral strategies (Martens et al., 2004), which include techniques to avoid rapidly rising BACs. More specifically, the protective behavioral strategies most pertinent to decreasing the likelihood for blackouts would include avoiding drinking games, not drinking shots of distilled spirits, and drinking slowly rather than gulping or chugging.

Testing the efficacy of avoiding these behaviors as a means to decrease the likelihood of experiencing blackouts could provide beneficial outcomes that include fewer social and emotional consequences.

Limitations and future directions

Current findings should be interpreted in light of several limitations. First, although blackouts in Year 4 were associated with an increase in alcohol-related consequences in Year 5, we cannot say that those consequences occurred as a direct result of alcohol-induced blackouts. Thus, we cannot infer a direct effect of blackouts on alcohol-related consequences at the event level. Second, the time frame for the assessment of alcohol-induced blackouts was 3 months during both years, which may not have accurately captured all participants who experienced blackouts across the entire year. Third, the sample in this study included only college students who endorsed drinking during a typical week, and thus the findings cannot be generalized to all drinkers. Nevertheless, our analyses included both men and women who drank at least once during a typical week, which means the sample was representative of a wider range of college student drinking patterns than those in previous studies (Anthenelli et al., 1994; Mundt et al., 2012). Fourth, our results are from only two assessments over a 1-year period that correspond to the transition out of college; therefore, they cannot generalize to longer periods of assessment or to other developmental periods, such as the transition into college.

Last, future studies should examine the association between alcohol-induced blackouts and negative outcomes at different developmental periods to determine whether these patterns hold across various ages. In particular, it would be interesting to examine the association between blackouts and alcohol-related problems in an older, albeit nonalcoholic, sample when heavy episodic drinking, and perhaps blackouts, may be less normative. Additionally, future studies could pilot intervention programs that specifically target strategies to decrease blackouts to determine whether they also decrease other negative alcohol-related outcomes.

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