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21st Birthday Drinking and Associated Physical Consequences and Behavioral Risks

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Abstract

Twenty-first birthday celebrations often involve dangerously high levels of alcohol consumption, yet little is known about risk factors for excessive drinking on this occasion. Participants ($N = 150$) from a larger prospective study who consumed at least one drink during their celebration completed questionnaires and semi-structured interviews about their 21st birthday within four days after the event. Assessments were designed to characterize 21st birthday alcohol use, adjusted for alcohol content, as well as situational/contextual factors (e.g., celebration location, peer influence) that contribute to event-level drinking. Participants reported an average of 10.85 drinks (9.76 adjusted drinks), with experienced drinkers consuming significantly more than relatively naïve drinkers who had no previous binge or drunken episodes. Men consumed more drinks, whereas age of first drunken episode and heavier drinking during the 3-months preceding the 21st birthday predicted higher estimated blood alcohol concentrations (eBACs) on the 21st birthday. Celebrating in bars and engaging in birthday-specific drinking traditions (free drinks at bars) explained additional variance in 21st birthday eBACs. Both physical consequences (e.g., blacking out or having a hangover) and behavioral risks (e.g., sexually provocative behaviors) were prevalent and were predicted by higher eBACs. Together these findings indicate that 21st birthday celebrations are associated with heavy drinking and a variety of physical consequences and behavioral risks.

Keywords

21st birthday; alcohol; alcohol-related problems; behavioral risk; physical consequences

The prevalence and consequences of heavy episodic drinking among college students has been well documented (e.g., Wechsler & Nelson, 2008), but recent event-level studies indicate that the heaviest and riskiest drinking occurs on specific days during the academic year (Del Boca, Darkes, Greenbaum, & Goldman, 2004; Neighbors et al., 2007). Arguably, 21st birthday celebrations rank among the heaviest drinking days with one study indicating that 28% of celebrants consumed 21 or more drinks and 40% exceeded their previous

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lifetime maximum number of drinks during their celebrations (Rutledge, Park, & Sher, 2008). Consistent with media accounts highlighting the perils of 21st birthday drinking (Forliti, 2008), many students (23–42%) achieved dangerously high estimated blood alcohol concentrations (eBAC) of at least 0.25 % during their celebrations (Neighbors, Spieker, Oster-Aaland, Lewis, & Bergstrom 2005; Rutledge et al., 2008).

Not surprising, many celebrants experience acute physical consequences of alcohol intoxication, such as blackouts, hangovers, and vomiting (Hembroff, Atkin, Martell, McCue, & Greenamyre, 2007; Lewis, Lindgren, Fossos, Neighbors, & Oster-Aaland, 2009; Wetherill & Fromme, 2009). Emerging evidence also indicates the occurrence of behavioral risks and other negative consequences during 21st birthday celebrations. Lewis, Neighbors, Lee, and Oster-Aaland (2008) reported that a large proportion of celebrants drove after drinking (23%), missed class or work the next day (28%), and had an argument with a friend (15%). Moreover the 21st birthday represents the “drinking debut” for a significant proportion of underage abstainers (36%; Rutledge et al., 2008), and at least one event-level study of non-birthday drinking found that risk for behavioral consequences was greatest for individuals who exceeded their typical light drinking (Neal & Fromme, 2007).

Although heavier drinkers tend to consume more alcohol during their 21st birthday celebrations (Day-Cameron, Muse, Hauenstein, Simmons, & Correia, 2009; Neighbors, Lee, Lewis, Fossos, & Walter, 2009; Rutledge et al., 2008), at least one study found that typically lighter drinkers who drank heavily during the week of their 21st birthday experienced significantly more negative consequences (Lewis et al., 2009), although the magnitude of these effects was small and baseline heavy drinking was not assessed prospectively. Consequently, we wanted to better characterize the birthday celebration experiences of relatively naïve drinkers (i.e., those who reported no prior occasions of drunkenness or binge drinking) and the possible risks that limited drinking experience may pose for 21st birthday drinking and related outcomes.

Clearly, many college students view extreme drinking as an integral part of the 21st birthday celebration, but less is known about specific factors that may influence their consumption. Previous research has shown that risk factors for generally heavier drinking, such as male gender, Greek membership, and younger drinking initiation, are also associated with heavier 21st birthday drinking (Day-Cameron, et al., 2009; Neighbors, et al., 2009; Rutledge et al., 2008). Additionally, the Theory of Planned Behavior (TPB; Ajzen, 1991) which includes social-cognitive factors such as attitudes, normative beliefs, subjective, and injunctive drinking norms, has provided a useful framework for understanding heavy drinking among college students (Collins & Carey, 2007; Collins, Witkiewitz, Larimer, 2011). Although normative misperceptions and heavier pre-celebration intentions have been associated with heavier 21st birthday drinking (Day-Cameron et al., 2009; Neighbors et al., 2009), the factors associated with TPB are less effective for predicting event-level heavy drinking as levels of consumption rise (Glassman, Braun, Dodd, Miller, & Miller, 2010) or when alcohol is readily available or free (Jamison & Myers, 2008; Skidmore & Murphy, 2011). In fact situational/contextual factors such as patronizing bars (Lewis et al., 2008), larger celebration groups (Hembroff et al., 2007), engaging in drinking traditions, and peer encouragement for drinking significantly contribute to both heavier drinking and exceeding pre-celebration drinking intentions (Brister, Wetherill, & Fromme, 2010). Thus, more proximal peer influence and environmental factors may exert a stronger influence on heavy event-level drinking than do attitudes and social norms.

Although prior studies have provided invaluable insight into the 21st birthday celebration, most findings come from intervention studies (e.g., Lewis et al., 2008; Neighbors et al., 2009), have been limited by low response rates (e.g., Neighbors et al., 2005) or use of

pooled data over multiple days (e.g., Lewis et al., 2009). Moreover, larger longitudinal studies have relied on highly retrospective data (average of 164 days; maximum = 762 days; Rutledge et al., 2008), which are further complicated by potential memory impairment resulting from extremely high levels of intoxication. Finally, the self-reported drinks that have been used to calculate eBAC in 21st birthday studies have not been standardized (Kaskutas & Kerr, 2008; White, Kraus, McCracken, & Swartzwelder, 2003).

The current study was designed to further our understanding of the nature and extent of 21st birthday celebrations in a number of important ways. First, we used semi-structured interviews to collect a detailed assessment of drinking behaviors and associated physical consequences and behavioral risks, and to probe the influence of situational factors on eBAC and resulting outcomes as they unfolded over the course of the celebration. We drew our sample from a (non-intervention) prospective cohort and relied less on retrospective data than similar studies. The first aim was to provide detailed descriptive information about the drinking behavior, physical consequences, and behavioral risks that occurred during the 21st birthday celebration, and to determine whether these differed by gender and prior drinking experience. Based upon prior research, we predicted that men would drink more heavily than women, and that heavier drinkers would consume more than lighter drinkers during their 21st birthday celebrations.

We also predicted that likelihood of experiencing physical consequences and engaging in behavioral risks would increase as celebration eBAC increased. Assuming higher than average consumption during their celebrations, we expected lighter drinkers to experience more physical consequences and behavioral risks, in part due to lower tolerance and less experience in coping with the effects of high levels of intoxication. When controlling for amount consumed, we refrained from making predictions about drinking experience as conflicting predictions could be made based on prior data (e.g., Lewis et al., 2008), and because heavier drinkers could have both higher tolerance (reducing risk) and higher levels of disinhibition (increasing risk).

Finally, we sought to replicate and expand upon the findings of Rutledge et al. (2008) by examining the additive influence of typical risk factors for heavy college drinking (e.g., gender, age of drinking onset) and event-specific risk factors on 21st birthday drinking. We hypothesized that event-specific situational factors, such as drinking locations, 21st birthday drinking traditions, and presence of influential peers, would contribute more to 21st birthday drinking than would risk factors for typically heavy drinking.

Method

Participants and Procedures

Students who were participating in a larger longitudinal study of college student drinking and behavioral risks at a large public Southwestern university (see Corbin, Vaughan, & Fromme, 2008 for additional details), and who were turning 21 during the spring semester of 2007, were identified for study inclusion ($N = 409$). For recruitment purposes, potential participants were classified as naïve (zero heavy drinking episodes) or experienced (1+ heavy drinking episode) drinkers using cumulative binge drinking and drunken episodes reported on web-based surveys collected from the fall of 2004 through the spring of 2006. The cutoff of one or more past heavy drinking episodes was selected to approximate the sample classification of experienced drinkers used by Rutledge et al. (2008); with these classifications subsequently verified using data collected during the fall 2006 web-based survey and interview session. We targeted a small sample of naïve drinkers based on the previous finding that an important minority of abstainers make their “drinking debut” on their 21st birthday (Rutledge et al., 2008). Nevertheless we did not expect these relatively

naïve drinkers to reach the same levels of intoxication as heavier and more experienced drinkers.

Potential participants who satisfied criteria as naïve or experienced drinkers completed a telephone screen ($n = 212$) approximately one week before their 21st birthday. We continued recruitment until we reached our goal of 150 participants ($n = 30$ naïve; $n = 120$ experienced) who: (a) had not yet celebrated their 21st birthdays, (b) indicated plans to drink at least one drink during their birthday celebrations, and (c) could come to the laboratory within 7 days after their celebrations. These participants then completed in-person sessions in which they provided informed consent, were weighed, indicated their number of distinct 21st birthday celebrations (range 1–5 unique events), and were directed to select and refer to a single main celebration when subsequently completing questionnaires and the semi-structured interview. All participants completed the 1.5–2 hour laboratory protocol within 4.1 ($SD = 2.3$; $Mdn = 4.0$) days of their 21st birthday celebrations, and were paid \$40 for their time.

Of those eligible and screened, 152 (72% response rate) completed the laboratory procedures. Two participants (1%) indicated that they did not drink despite pre-celebration intentions and were excluded from analyses. Five participants initially classified as naïve drinkers reported at least one heavy drinking episode prior to their 21st birthday celebration (range 2–15 occasions) and were re-classified as experienced drinkers. The final sample consisted of 150 participants (50% women; 83% experienced drinkers).

Measures

Demographic and background factors—Gender (1 = *male*, 0 = *female*), Greek membership (1 = *member*; 0 = *nonmember*), and ethnicity (1 = *Caucasian*; 0 = *other ethnicity*), were obtained from the fall 2006 web-based survey of the parent study.

Drinking history—Single-item questions with open-ended responses assessed the number of past 3-month binge drinking episodes (i.e., five or more drinks for men or four or more drinks for women during a single occasion [Wecshler, Dowdall, Davenport, & Rimm, 1995]) and drunken experiences (defined as “getting drunk (not just a little high) on alcohol” [Jackson, Sher, Gotham, & Wood, 2001]). These items were completed for each wave of data collection in the parent study and during the laboratory session. The laboratory measure specifically indicated that responses should not include the 21st birthday celebration, and these items were summed to create a past 3-month heavy drinking composite variable (range = 0–49 episodes). The continuously scored heavy drinking composite demonstrated good internal reliability (coefficient alpha = .89).

At the beginning of the laboratory session, participants also completed measures of lifetime maximum drinking (range = 0–50 drinks), whether 21st birthday consumption exceeded their lifetime maximum (1 = *yes*; 0 = *no*), and age of first drink and drunken episode (i.e., never, prior to age 9, 9–12, 13–15, 16, 17, 18, 19, after age 20).

The Birthday Experiences Checklist (BEC)—The BEC was designed for the current study to provide comprehensive descriptive information about celebration experiences and to prompt interviewers to conduct in-depth follow up assessments for potentially dangerous behaviors such as sexual activity¹, driving after drinking, and blackout. To maximize content validity, a variety of behaviors, which ranged from alcohol-related consequences

¹The BEC also assessed consensual or coerced sex as a single item. Further examinations of follow up data collected during the BCSI-21 revealed that all 15 occasions of sexual activity were consensual and with a monogamous partner (93%). Further, the majority of participants (93%) reporting using a condom during sex, consequently sexual activity was excluded as a behavioral risk.

(e.g., blackout) to benign social activities (e.g., sing Karaoke), were taken from the Rutgers Alcohol Problem Index (White & Labouvie, 1989; e.g., missing class), popular press accounts (e.g., drunk dialing), event-level studies (e.g., non-typical tobacco use), and the longitudinal parent survey (e.g., legal problems, theft). From a pool of 37 items, two rationally derived subscales were created by separately summing four physical consequence items (blackout, hangover, vomiting, and falling down) and 21 behavioral risks items (e.g., drug use, driving after drinking). Subscale counts rather than likelihood estimates were collected because the 24-hour assessment period restricted opportunities to engage in these behaviors. Derived from checklists, it was not surprising that the physical consequences ($\alpha = .73$) and behavioral risks ($\alpha = .67$) subscales demonstrated only modest internal reliability.

Semi-structured Interviews—The Birthday Celebration Structured Interview-21 (BCSI-21; Stappenbeck, Brister, & Fromme, 2007)² was developed for the current study to assess detailed information about the main celebration, including alcohol use (e.g., number/types of drinks, time spent drinking), transportation, and hypothesized event-specific risk factors including number and types of celebration locations (e.g., bar, house party, restaurant), and 21st-birthday-specific drinking traditions (e.g., free shots/drinks at bars, “21 on 21,” “power hour”)³. The BCSI-21 also collected the initials of up to three influential peers who were considered by participants to be instigators—“friends that try to influence the celebratory atmosphere and encourage drinking and other behaviors,” or caretakers—“friends that [you could] count on more than others to help take care of [you] in situations and keep you safe and out of trouble.” Numbers were summed for 21st birthday-specific drinking traditions, bars visited, instigators, and caretakers (reverse-scored as their absence was considered a risk factor for heavier drinking and more negative outcomes). Number of free drinks was calculated as a proportion of celebration drinks provided by restaurants, bars, or other people relative to total drinks consumed.

Interviewers assessed the time of first and last drink (to calculate total duration of drinking) and the number of standard drinks consumed at each drinking location using a 24-hour, 15-minute increment celebration timeline that was adapted from validated timeline follow-back methods (Sobell & Sobell, 1992). To facilitate accurate recall, interviewers described and visually represented standard drink volume and alcohol content using a variety of glasses, cups, and bottles. Participants also reported specific drink names for each shot and mixed drink consumed, which allowed research staff to adjust the actual alcohol content for each drink using drink recipes obtained from online databases (i.e., Webtender.com) or from local bartenders and restaurants. For example, free birthday shots provided by bars and restaurants were recoded as 0.5 standard drinks; a 1.5 oz. shot containing 151-proof rum was recoded as 2.27 standard drinks; and a Mexican martini, a popular local drink, was recoded as 2.5 standard drinks.

Estimated blood alcohol concentrations (eBAC)—Using information obtained from the BCSI-21, participants eBACs were calculated using the Matthews and Miller (1979) formula: $BAC = [(Number\ of\ drinks/2) \times (gender\ constant/weight)] - ([0.017\ g/dl] \times drinking\ duration\ in\ hours)$; gender constant (9 for females and 7.5 for males), and 0.017 was the metabolism rate of alcohol per hour. One extreme eBAC value (0.71) was recoded as the next highest eBAC value (0.46), and negative eBACs (indicative of very light drinking; $n = 5$) were recoded as 0.00. Estimated BACs adjusted for alcohol content and time spent drinking were used for all analyses⁴.

²The BCSI-21 and interviewer’s manual are available from the authors.

³Drinking traditions were selected based on anecdotal, empirical, and popular press accounts of 21st birthday celebrations (e.g., Forlotti, 2001; Grissom, 2005).

Because data derived from the BCSI-21 were obtained via semi-structured interviews, two independent raters coded transcribed interview responses and audio tapes ($n = 150$), and they generally reached excellent agreement (Kappas from .69 to 1.0). Additionally, the principal investigator (K.F.) reviewed a random selection of interview audio tapes ($n = 6$) to ensure adherence to the detailed interviewer's manual, including standardized use of non-judgmental, open-ended questioning, and appropriate follow up questions.

Results

Comparisons of heavy drinking episodes from the longitudinal web-based surveys (used in recruitment) and laboratory-based measures confirmed that experienced drinkers reported significantly more binge ($M = 28.39$, $SD = 37.93$) and drunken ($M = 21.50$, $SD = 29.72$) episodes during the cumulative assessment periods prior to the 21st birthday than naïve drinkers (binge, $M = 0.44$, $SD = 0.51$; drunk, $M = 0.08$, $SD = 0.28$) (Wilks' Lambda = .91; $F(2,142) = 6.65$; $p < .01$), thus providing support for our naïve and experienced classifications. The continuously scored past 3-month heavy drinking composite score was used in primary study analyses, whereas the naïve and experienced categorical variable was used to aid in the presentation of descriptive data.

Table 1 presents descriptive data and comparisons by gender and categorical drinking history for 21st birthday drinking, birthday traditions, drinking locations, and means for getting home. To minimize type I error rate inflation, critical p -values for each of the 32 comparisons were adjusted using the Benjamini-Hochberg procedure (see Benjamini & Hochberg, 2000; Williams, Jones, & Tukey, 1999). Results indicate that the majority of participants engaged in at least one birthday-specific drinking tradition (58%), but relatively few consumed 21 drinks ($n = 3$) or engaged in power hour ($n = 1$). Of note, very few participants drove after consuming three or more drinks ($n = 4$; 3%), although a sizeable minority rode with a driver who had been drinking ($n = 40$; 28%). Consistent with hypotheses, men consumed more standard (and adjusted) drinks than women, although, notably, women achieved higher eBACs. Also consistent with hypotheses, experienced drinkers consumed more than naïve drinkers. Figure 1 illustrates cumulative percentages of self-reported and alcohol content adjusted standard drinks (Panel A), adjusted time spent drinking (Panel B), and eBAC (Panel C) by gender.

Many participants (42%) also consumed more drinks during their 21st birthday celebrations than their previous lifetime maximum. Separate two-way ANOVAs were conducted to further examine potential gender and categorical drinking history (naïve or experienced) differences in unadjusted standard drinks consumed by occasion (21st birthday; previous lifetime maximum drinks). Results revealed a significant drinking history by occasion interaction, $F(1,148) = 6.41$; $p < .05$, such that only naïve drinkers, relative to experienced drinkers, consumed more during their 21st birthdays than their previous lifetime maximum (see Table 1).

⁴The study design allowed participants to report multiple drinking occasions during the 24 hour period of their celebration day. To reduce risk of biasing calculated eBACs, number of drinks and total time spent drinking were reduced if time between locations and drinks at previous location exceeded a 2:1 ratio. For example, the number of drinks and total time spent drinking would be reduced by 2.5 drinks and nine hours for a participant reporting one noon time Mexican martini followed by six additional 12 oz. beers consumed between the hours of 9:00 PM and midnight. In the current study number of drinks were reduced by approximately 1.18 drinks ($Mdn = 1.0$; $SD = 0.37$), whereas total time spent drinking was reduced by approximately 4.59 hours ($Mdn = 4.13$ hours; $SD = 1.93$) for 14 participants. Estimated BACs calculated from participant self-reported number of standard drinks and time spent drinking were significantly correlated ($r = .66$; $p < .001$) with investigator-adjusted eBAC that were based on actual alcohol content of each drink consumed as well as adjusted total time spent drinking.

Physical Consequences and Behavioral Risks of 21st Birthday Celebrations

Prevalence rates for each physical consequence and behavioral risk as well as by gender and categorical drinker history are presented in Table 2. Overall celebrants experienced 1.7 ($SD = 1.5$) physical consequences and engaged in 2.1 ($SD = 2.1$) behavioral risks during their celebrations. Mann-Whitney test of independent groups revealed that naïve drinkers experienced fewer physical consequences ($U = 666.50$; $p < .001$) and engaged in fewer behavioral risks ($U = 825.50$; $p < .001$) relative to experienced drinkers; there were no gender difference for either type of outcome (all p -values $> .05$). Physical consequence and behavioral risk counts as a function of 21st birthday eBAC and continuously scored past 3-month drinking were examined using separate negative binomial regressions. Estimated BAC was multiplied by 20, so that regression coefficients are expressed as a function of a .05% change in eBAC. Past 3-month drinking and scaled eBAC were next centered to reduce non-essential collinearity between the main effects, quadratic terms, and main effects cross-product. We included eBAC and past 3-month quadratic terms to minimize the possibility that the interaction term reflected unmodeled quadratic terms, a major methodological issue when predictor (eBAC) and moderator (past drinking) are highly correlated ($r = .28$; $p < .01$; see Cortina, 1993; Lubinski & Humphries, 1990). Model testing proceeded in three sequential steps: (1) main effects only, (2) main effects and quadratics, and (3) main effects, quadratics, and interaction. Nested model log-likelihood ratios comparisons indicated that adding quadratic terms significantly improved physical consequence model fit (χ^2 Difference (3, $N = 145$) = 12.84, $p < .001$), marginally improved behavioral risk model fit (χ^2 Difference (1, $N = 145$) = 2.35, $p = .09$), but interactive terms did not (all p -values $> .05$).

Consistent with hypotheses, achieving higher celebration eBAC was associated with more physical consequences (OR = 3.22; 95% CI = 2.38 – 4.35; $p < .001$) and greater behavioral risk engagement (OR = 1.38; 95% CI = 1.09 – 1.75; $p < .01$). Analyses also revealed a trend such that typically lighter past 3-month drinking patterns (eBAC $\times$ Past 3-Month Drinking OR = 0.78; 95% CI = 0.58 – 1.06; $p = .10$) attenuated physical consequence risk at higher eBACs. Figure 2 presents visual representation of probabilities of the most commonly reported physical consequences (hangover, vomiting, and falling/slipping/stumbling) as a function of eBAC and categorical drinking history⁵.

Despite low power for detecting interactive effects of celebration eBACs by past 3-month heavy drinking on physical consequences (.67) and behavioral risks (.63), we conducted post-hoc exploratory analyses of celebration experiences between experienced and naïve drinkers (categorical drinking history) as a potential explanation for the non-significant contribution of eBAC to behavioral outcomes. In addition to naïve drinkers achieving lower eBACs (.08%; experienced = .21%), they were more likely to celebrate at a restaurant (64%; experienced = 37%), with a significant other or family member (42%; experienced = 21%), and less likely to report celebrating with a caretaker (80%; experienced = 93%) relative to experienced drinkers (all p -values $< .05$). It appears that naïve drinkers had qualitatively different, and potentially less risky, 21st birthday celebrations than experienced drinkers.

Typical and Event-Specific Risk Factors for Heavy 21st Birthday Drinking

Risk factors for heavier 21st birthday drinking were examined using two separate hierarchical linear regression analyses. The first model examined demographic and background factors that have been associated with heavier typical drinking (i.e., gender, ethnicity, age of first drink, age of first drunken episode, Greek status, and continuously

⁵Black outs were not examined as only one naïve drinker reported a celebration black out. To aid portrayal of results, categorical drinking history (naïve vs. experienced as described above) was used to plot eBAC by pre-21 heavy drinking interactions (Figure 2). However, note that the continuously distributed pre-21 heavy drinking composite was used in regression analyses.

scored past 3-month heavy drinking). Results indicated that female gender, having the first drunken episode at a younger age, and heavier past 3-month drinking predicted higher 21st birthday eBAC (all p -values < .05); these factors were retained and served as the first block of the final model.

To examine the possible additional contribution of event-specific risk factors, birthday-specific risk factors (i.e., numbers of bars visited, celebrants, instigators, caretakers, and 21st-birthday-specific drinking traditions) were then entered in the second block. Proportion of free drinks (participants personally paid for only 5% of their drinks) and adjusted time spent drinking were removed from the final model because collinearity diagnostics indicated unacceptably low tolerance statistics (Toutenberg, 2002). The final regression model results and bivariate correlations between risk factor and eBAC are presented in Table 3. Results indicate that background/demographic (Adjusted $R^2 = .24$) and event-specific (Adjusted $R^2 = .27$) risk factors contribute significantly and approximately equally to celebration eBACs.

Discussion

The current study builds upon recent findings documenting the nature and prevalence of extreme celebration drinking and related negative outcomes. Major challenges inherent to self-report assessments of extreme drinking events such as the 21st birthday include inaccurate recall (related in part to cognitive impairment and blackouts) and variability in alcohol content (beverage volume and concentration). In contrast to the majority of previous studies (e.g., Day-Cameron et al., 2009; Neighbors et al., 2009), the current study attempted to address this variability by using a “drink-by-drink” reconstruction of the celebration and by obtaining information from the establishments frequented by celebrants. These innovations bolster our confidence in estimates of extreme drinking as compared to studies that were insufficiently attentive to drink variability and did not provide a framework for careful reconstruction of the drinking episode. Despite the diligent attempts at reconstructing the drinking episode, drink-by-drink, we note that 40% of the participants reported a blackout for part of the evening, suggesting that accounts of celebration drinking and negative outcomes may have been based on inference and second-hand information as opposed to accurate recall. Further, both the physical consequence and behavioral risk subscales were rationally-derived from items included in the Birthday Experiences Checklist, which was designed to characterize 21st birthday experiences by sampling a wide range of potential events. We note that both coefficient alphas were below .80, although this is not uncommon for “event inventories” where the experience of one event does not necessarily imply the occurrence of another (Aldwin, 2007). Regardless, we believe the methods reported here provide the foundation for the most accurate characterization of the 21st birthday celebration currently available.

Consistent with previous studies, celebrants drank heavily, even after adjusting for alcohol content of each drink, and a sizeable minority achieved potentially dangerous estimated BACs. Further, the majority of celebrants engaged in at least one birthday-specific drinking tradition, but a smaller proportion (2%) engaged in “21 on 21” (i.e., consuming 21 drinks on the 21st birthday) compared to previous findings (Rutledge et al., 2008), perhaps reflecting differences in the campuses studied.

Specific Outcomes Associated with 21st Birthday Drinking Excess and Drinking History

To our knowledge, the current study was the first to separately examine physical consequences and behavioral risks as they relate to intoxication levels during 21st birthday celebrations. Achieving higher celebration eBACs increased the likelihood of experiencing physical consequences and engaging in other behavioral risks.

Individuals with more extensive drinking experiences consumed the most alcohol and were more likely to have adverse physical outcomes during the 21st birthday celebration. In seeming contrast to one set of previous findings (e.g., Lewis et al., 2008), individuals who exceeded their typical light drinking levels were not significantly more likely to experience negative outcomes during 21st birthday celebrations. Whereas our analyses were under-powered to detect interactive effects, the modeling of interactions between highly correlated predictors (e.g., 21st birthday eBAC) and moderators (e.g., past drinking pattern) can be misleading, especially when the relation between predictor and outcome is nonlinear (as are most dose-response curves). Apparent interactions may simply reflect different positions on a dose-response curve for lighter and heavier drinkers, and in such cases, it is necessary to model quadratics and/or use spline regressions. Nevertheless, post hoc analyses of situational factors revealed that naïve drinkers had qualitatively different types of celebrations (e.g., with family at restaurants), that were potentially less risky than those of experienced drinkers (e.g., with friends at bars). Future studies recruiting larger samples of both typically lighter drinkers and heavier drinkers who have comparable event-level consumption may help clarify these conflicting findings.

Event-Specific Risk Factors for Heavy Celebration Drinking

The current study found that event-specific risk factors such as celebrating at bars and engaging in 21st-birthday-specific drinking traditions predicted higher eBACs. Thus, 21st birthday celebrations appear to be best conceptualized within comprehensive frameworks such as social learning theories (Bandura, 1977), which emphasize peer influence (Borsari & Carey, 2006), and behavioral theories of choice (Premack 1965) which highlight the importance of environmental context (Correia, Simmons, Carey, & Borsari, 1998; Skidmore & Murphy, 2011) in addition to background social-personality factors.

Implications for Intervention

Previous individual-level interventions have proven to be only modestly effective, leading several authors to conclude that creative and comprehensive strategies are needed to address the risks of extreme 21st birthday drinking (e.g., Lewis et al., 2008; Neighbors et al., 2009). Current findings suggest that a comprehensive understanding of the 21st birthday celebration can guide intervention strategies that specifically target the most influential local risk factors. For example, rates of intoxicated driving were considerably lower than those reported previously (Lewis, et al., 2008), perhaps because the majority of celebrants (43%) in the current study used public transportation, spent the night at their primary celebration location, or rode with a friend or designated driver. Our findings appear to provide support for local campus/community sober transportation programs and to identify house party attendance and using designated drivers as protective against intoxicated driving. Further, implementing peer-based interventions for “friends helping friends” and more consistent use of designated-drivers might particularly benefit students as the presence of caretaking peers in the current study did not protect students against heavy drinking or potential risks, and importantly, over one-quarter of celebrants rode with a non-sober friend or designated driver.

Recent findings indicate that low cost drinks are among the strongest predictors of heavy drinking (Jamison & Myers, 2008; Skidmore & Murphy, 2011) and suggest that environmentally-based interventions curtailing the provision of free drinks may be more effective for reducing extreme drinking than norms-based interventions (Kuo, Wechsler, Greenberg, & Lee, 2003). Celebrants in the current study paid for less 5% of their drinks and frequently endorsed drinking free shots, often while bar hopping. Further, 55% of current study participants received free drinks at bars or restaurants as compared to 19% of celebrants in Michigan, where such practices are illegal (Hembroff et al., 2007). Similar

strategies represent an intriguing target for future interventions that could potentially address the most relevant local risk factors for the current participants and their peers.

Finally, although use of protective behavioral strategies has not been associated with reduced drinking on 21st birthdays (Neighbors et al., 2009), celebrants may still anticipate risk and plan strategies to avoid them (Lewis, Kaysen, Rees, & Woods, 2010; Martens, Pedersen, LaBrie, Ferrier, & Cimini, 2007). For example, our results suggest that holding one's 21st birthday celebration in a restaurant contributed to lower levels of intoxication than barhopping. Although there are many reasons why relatively naïve drinkers may have chosen less risky celebrations, an understanding of their planning and decision-making processes may provide insights into encouraging safer celebrations among all drinkers. In conjunction with environmental and policy interventions described earlier, the application of brief motivational enhancement interventions, such as those used to encourage participation in alcohol-free or moderate drinking activities (Murphy, Correia, Colby, & Vuchinich, 2005) might also be used to reduce extreme event-related drinking and resulting consequences.

Conclusions and Future Directions

The current study is perhaps the most comprehensive assessment of the 21st birthday study to date. Using timeline follow-back and structured interview procedures within a short time after the 21st birthday event allowed for a detailed assessment of the individual, social, and environmental influences on drinking and related physical and behavioral outcomes. Thus, these methods could be extended to other settings (e.g., emergency rooms) and situations (e.g., repeated arrests for driving while intoxicated) in which a better understanding of the contextual factors surrounding heavy episodic drinking might help inform intervention efforts.

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Figure 1.
Cumulative percentage of participant drinking behaviors.

Figure 2.
Likelihood of experiencing specific physical consequences as a function of estimated BAC and by drinking history.

Table 1

Descriptive Data for the 21st Birthday Celebration by Drinking History and Gender

Variable	Drinking History				Gender	
	All celebrants N = 150	B-H rank ^c	Experienced n = 125	Naïve n = 25	B-H rank ^c	Men n = 75
Self-reported drinks ^{a, b}	10.85 (6.27)	29	12.46 (6.92)	4.12 (3.06)	28	12.63 (6.60)
Adjusted drinks ^{a, b}	9.76 (5.44)	30	10.68 (5.24)	4.53 (3.86)	27	11.19 (5.53)
Adjusted eBAC ^b	0.19 (0.13)	31	0.21 (0.14)	0.08 (0.09)	19	0.17 (0.10)
Previous maximum drinks ^{a, b}	10.93 (7.53)	32	13.78 (6.08)	2.53 (2.60)	26	12.48 (7.17)
Exceeded previous maximum drinks ^b	63 (42.0%)	18	49 (39%)	14 (56%)	13	32 (42.0%)
Any 21 st birthday tradition	87 (58.0%)		79 (63%)	11 (44%)		44 (59.0%)
Drank at midnight ^b	33 (22.0%)	25	31 (25%)	2 (8%)	5	16 (21.0%)
Free shots at bars	82 (55.0%)	17	75 (60%)	8 (32%)	9	40 (53.0%)
Drank 21 shots	3 (2.0%)		3 (2%)	0		2 (2.7%)
Power hour	1 (0.7%)		1 (<1%)	0		1 (1.3%)
Visited bar ^b	103 (69.0%)	21	92 (74%)	11 (44%)	15	55 (73.0%)
Barhopping ^b	85 (57.0%)	24	77 (62.0%)	8 (32%)	7	43 (57.0%)
Attended a house party	16 (11.0%)		13 (10%)	3 (12%)		6 (8.0%)
How participant got home						
Stayed at location	22 (15.0%)	3	18 (14%)	4 (16%)	10	13 (17.0%)
Bus/cab	20 (13.0%)	6	18 (14%)	3 (12%)	12	13 (17.0%)
Bike/walk	5 (3.3%)	11	5 (4%)	0	4	2 (2.7%)
Drove self	6 (4.0%)	8	4 (3%)	2 (8%)	1	3 (4.0%)
Designated driver ^b	20 (13.0%)	23	20 (16%)	0	2	11 (15.0%)
Designated driver or friend drank before driving	40 (28.0%)		32 (26%)	8 (32%)		21 (28.0%)
						19 (25.0%)

Notes. Table presents means and standard deviations and frequencies and percentages reporting behaviors for overall sample, by gender, and drinking history classification.

Means compared using independent samples *t* tests with unequal variances assumed; categorical variables compared using Fisher's exact tests.

^a Significant gender differences.

^b Significant previous drinking experience classification differences.

^c Significance tests were adjusted for 32 multiple comparisons using Benjamini Hochberg procedure for False Discovery Rate (B-H FDR) correction. Critical B-H p values for significant tests ranged from .05 (driving self home by gender; B-H rank 1) to .0016 (previous lifetime maximum by drinking history; B-H rank 32; Blank B-H rank indicate that no comparisons were made).

Table 2
21st Birthday Physical Consequence and Behavioral Risk Descriptive Data and Outcome Counts

Outcome	Gender		Drinking History		All Celebrants	
	Men <i>n</i> (%)	Women <i>n</i> (%)	Experienced <i>n</i> (%)	Naïve <i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Physical Consequence	1.8 (1.5)	1.6 (1.4)	2.0 (1.5)^a	0.5 (0.8)^a	1.7 (1.5)	
Next day hangover	34 (45%)	34 (45%)	64 (53%)	4 (13%)	68 (45%)	
Vomit after drinking	30 (40%)	23 (31%)	47 (39%)	6 (20%)	53 (35%)	
Black out	26 (35%)	35 (47%)	60 (50%)	1 (3%)	61 (41%)	
Fall/stumble/slip	33 (44%)	39 (52%)	66 (55%)	6 (20%)	72 (48%)	
Behavioral Risk	2.3 (2.2)	2.0 (2.0)	2.4 (2.1)^a	0.92 (1.4)^a	2.1 (2.1)	
Citation for public intoxication ^b	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Trespass or break in ^b	0 (0%)	1 (1%)	0 (0%)	1 (3%)	1 (<1%)	
Legal problems (arrest/citation/warning) ^b	0 (0%)	1 (1%)	1 (<1%)	0 (0%)	2 (1%)	
Drove after drinking 3+ drinks	2 (3%)	2 (3%)	4 (3%)	0 (0%)	4 (4%)	
Drug use	5 (7%)	2 (3%)	7 (6%)	0 (0%)	7 (5%)	
Strip or skinny dip	7 (9%)	2 (3%)	8 (7%)	1 (3%)	9 (6%)	
Act provocatively (e.g., dirty dance)	14 (19%)	13 (17%)	25 (21%)	2 (7%)	27 (18%)	
Flirt or try to seduce someone	19 (25%)	16 (21%)	32 (27%)	3 (10%)	35 (23%)	
Make out with one or more people	21 (28%)	22 (29%)	34 (28%)	9 (30%)	43 (29%)	
Pull prank on friend/stranger	2 (3%)	0 (0%)	1 (<1%)	1 (3%)	2 (1%)	
Urinate somewhere other than toilet	9 (12%)	0 (0%)	0 (0%)	0 (0%)	9 (6%)	
Dance on bar or tables	4 (5%)	11 (15%)	13 (11%)	2 (7%)	15 (10%)	
Make a big scene	10 (13%)	8 (11%)	17 (14%)	1 (3%)	18 (12%)	
Non-typical tobacco use	13 (17%)	10 (13%)	21 (18%)	2 (7%)	23 (15%)	
Drunk dial/Myspace/Facebook	21 (28%)	20 (27%)	39 (33%)	2 (7%)	41 (27%)	
Embarrass self	18 (24%)	21 (28%)	38 (32%)	1 (3%)	39 (26%)	
Verbal/physical fight	4 (5%)	4 (5%)	7 (6%)	1 (3%)	8 (5%)	
Trouble with bouncer/friends/parents	0 (0%)	2 (3%)	2 (2%)	0 (0%)	2 (1%)	
Late for work/school because of drinking	7 (9%)	5 (7%)	11 (9%)	1 (3%)	12 (8%)	
Missed work/school because of drinking	11 (15%)	14 (19%)	24 (20%)	1 (3%)	25 (17%)	

Note. Mean count scores and standard deviations for overall sample and by gender and categorical drinking history are presented in bold.

^a Counts were significantly differences based on Mann-Whitney tests for independent groups

^b Item excluded from Behavioral Risk Count Variable because of low prevalence.

Table 3

Demographic, Background, and Event-Specific Risk Factors for Achieving Heavier 21st Birthday estimated BAC

Risk factor	<i>r</i>	Step 1 $\beta(b)$	Step 2 $\beta(b)$
Female Gender	.16*	.20 (.05)**	.19 (.05)**
First time drunk	.40***	.28 (.02)**	.22 (.02)**
Typical drinking ^a	.35***	.28 (.01)**	.20 (.01)**
Bars visited	.38**		.22 (.03)**
Birthday-Specific Drinking Traditions	.52***		.29 (.05)***
Number of celebrants	.05		.08 (.00)
Instigators	.24**		.08 (.01)
Caretakers ^b	.33***		-.14 (-.02)*
Adjusted <i>R</i> ²		0.22	0.47 ^c

Notes.

^aTypical Heavy drinking refers to the continuously scored past 3-month heavy drinking composite.

^bNumber of caretakers was reverse coded; results indicate that presence of more caretakers was associated with achieving higher celebration eBACs.

^cSignificant incremental F change scores (F-Change= 14.26; $p < .001$) indicate that second block (event-specific) significantly predicted additional eBAC variance.

*
 $p < .05$

**
 $p < .01$

 $p < .001$