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"On a night like this": A mixed-methods approach to understanding high-risk drinking events in college students

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Abstract

Background: Previous research indicates college students report heavier drinking on certain events (e.g., 21st birthday). While past research has identified heavier drinking events, students' own reports of what events are associated with elevated drinking remains understudied. The current study utilized mixed methods to explore potential high-risk drinking events for college student drinkers and how these events differed from typical drinking and each other.

Methods: College student drinkers (N=204) reported number of drinks consumed on nine predetermined events (e.g., Halloween). Students also responded to open-ended questions listing five events during which they had elevated drinking, and indicating amount consumed on each event. Open-ended responses were coded into similar event categories. Descriptive statistics for drinks consumed were calculated for predetermined and coded open-ended events. Chi-square analyses assessed differences in endorsement of open-ended events by birth sex, age, and Greek membership. Two multilevel count regressions assessed within-person differences in number of drinks consumed between participants' typical drinking occasions and 1) highly endorsed open-ended events and 2) predetermined events.

Results: For all open-ended event categories, average number of drinks consumed exceeded heavy episodic drinking thresholds; however, there was substantial variability. Comparing predetermined events to participants' typical drinking indicated elevated drinking on participants' birthdays, New Year's Eve, Halloween, Finals, and Spring Break; significant differences between events also emerged. Comparison of open-ended categories to participants' typical drinking indicated elevated drinking on birthdays, celebrations, parties, and holidays; however, there were no significant differences between open-ended events.

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Conclusions: Students who drink alcohol report heavier drinking on specific calendar-based events (e.g., Spring Break). However, students also report non-calendar related events (e.g., non-specific parties) as some of their highest drinking events. More research is needed to understand how intervention and prevention programs can be adapted to target both known calendar-based high-risk drinking events, and unknown, idiosyncratic high-risk drinking events.

Keywords

Event-specific drinking; alcohol use; mixed methods; college students; celebratory drinking

College student alcohol use continues to be a public health concern contributing to numerous short- and long-term consequences, including compromised emotional and physical health, impaired academic performance, relationship difficulties, injuries, legal consequences, alcohol use disorder, and fatalities (e.g., Barnett et al., 2015; Patrick et al., 2020; White & Hingson, 2013). While college student intervention and prevention programs have mostly focused on general alcohol use, research has also demonstrated that drinking on specific events, such as Spring Break (e.g., Lee et al., 2009) or New Year's Eve (e.g., Tremblay et al., 2010), can be common, excessive, and associated with increased risks and consequences (Lee et al., 2006; Lewis et al., 2009). Assessing drinking during specific events may provide information about those events and about future drinking behaviors. For example, heavy drinking on one's 21st birthday and during orientation week have both been associated with later reports of drinking and consequences (Geisner et al., 2017; Riordan et al., 2018). Interventions developed for drinking on specific high-risk events have been shown to reduce drinking on that event (e.g., Lee et al., 2014) and in some cases, more general drinking behaviors (Cadigan et. 2019; Ridoran et al., 2015), indicating information about high-risk events can provide utility to efforts to reduce drinking.

While past research suggests targeting high-risk drinking events may be an efficacious intervention approach, research identifying which events are deemed "high-risk drinking events" (HRDE) is limited. Events formerly targeted have primarily been determined through previous studies of events based on calendar dates (e.g., New Year's Eve – Dec 31st) that have predominantly used samples of first-year college students (e.g., Del Boca et al., 2004; Beets et al., 2009). However, depending on the context, college, or seasonality, some events have mixed findings regarding their level of risk. For example, St. Patrick's Day, in some studies, evidenced higher drinking than Spring Break (Henslee et al., 2016), whereas other studies showed St. Patrick's Day had lower alcohol use compared to other events, including Spring Break (Neighbors et al., 2011). There are several other events that evidence variability in alcohol use by context and timing (e.g., Halloween, Veteran's Day, Memorial Day; Ehlke et al., 2021; Henslee et al., 2015, Neighbors et al., 2011), and therefore, it is currently unclear how best to typify these events with contrasting findings. Conversely, some events, such as New Year's Eve and Spring Break, have been consistently associated with increased drinking among college students across studies (e.g., Beets et al., 2009; Neighbors et al., 2011), indicating some calendar-based events may consistently provide elevated risk, whereas the level of risk for other events may be dependent on additional factors.

Some of these factors may be related to local cultural and college- or age- specific norms and practices, which is supported by some research targeting events based on these parameters (e.g., Henslee et al., 2016). For example, campus-specific events have been associated with increased alcohol use and problems within the community (e.g., State Patty's Day; Lefkowitz et al., 2012). Campuses with different traditions around events vary in their alcohol use during these events (e.g., St. Patrick's Day and Mardi Gras; Henslee et al., 2015). Geographical-location-specific events also impact college student alcohol use (e.g., "Guavaween"; Del Boca et al., 2004), as do when certain events occur (e.g., at the beginning of the semester versus exams; Tremblay et al., 2010), and for some groups, some events may pose more risk compared to other groups, possibly due to context or group dynamics. For example, increased alcohol use when celebrating 21st birthday was associated with both celebrating in a sorority/fraternity location and celebrating with sorority/fraternity members (Rodriguez et al., 2016). North American football (and the associated pre-game) is another event that seems to vary by context, as some studies find elevations in alcohol use (e.g., Neal & Fromme, 2007; Merlo et al., 2011) while other studies have not found that football is associated with increased alcohol use (Beets et al., 2009). Moreover, a "21st birthday effect" is observed in young adults where alcohol consumption during 21st birthday celebrations is significantly greater compared with other young adult birthdays (Gilson et al., 2021). Taken together, these studies indicate what may constitute a HRDE can vary by temporality and context.

Adding to the complexity of defining HRDE, there is evidence that not only does quantity of alcohol potentially vary by event (Neighbors et al., 2011), so does endorsement of each event (e.g., whether drinking occurred at all; Ehlke et al., 2021). Subsequently, from a conceptual view, a HRDE may be determined by a higher percentage of students endorsing drinking at that event. However, a HRDE may also be defined as events less consistently endorsed but where use is considerably higher for some portion of the population. Both could be important given either the potential to impact more students and represent a larger target for prevention and intervention efforts or to present a higher-risk event for a subpopulation.

While previous approaches to assessing HRDE in college students have been informative, little is known regarding students' perceptions of events during which they had elevated drinking. By not soliciting students' self-reported events, previous research may have unintentionally omitted important events that represent HRDE because they are not readily apparent to researchers or not designated by a specific calendar day. Given current inconsistencies and gaps in knowledge, utilizing a qualitative approach may be warranted to identify HRDE better and understand how students view their own HRDE. By asking students directly about events during which they had elevated drinking, a more nuanced understanding can be gained that would supplement existing event-specific studies by providing key information that is currently absent—namely, an understanding of how aligned or not students' nominations of high-risk events are with the current state of research. Further, by extending the qualitative approach to a mixed-methods approach, we can expand our understanding to quantitatively examine how much alcohol is being used in these idiosyncratic events compared to students' self-reported typical drinking. This information would help inform interventions both broadly and specifically. Broadly, the

more frequently endorsed events associated with alcohol use could be targets for more universal intervention. Conversely, events that may be less endorsed but evidence increased use and consequences for some individuals could represent specific targets for tailored interventions. This combined approach would allow interventions to blend both broad and specific objectives in a valuable and conceivable way. Prior to and during intervention engagement, events can be asked about as they occur within a specific time frame; thus, making them useful points for the intervention to focus on in an anticipatory manner. Hence, events represent targeted points of influence that can be implemented at multiple levels—from broad prevention to indicated intervention—while still implementing other intervention efforts.

Current Study

The current study was an exploratory mixed-methods analysis that had two aims: 1) to examine HRDE using both open-ended responses self-identified as events with elevated drinking by college students and closed-ended calendar events based on previous research among college student drinkers (e.g., New Year's Eve, Spring Break) and 2) to investigate if increased alcohol consumption was observed on these self-reported and calendar-based events compared to students' self-reported typical drinking. Additional exploratory analyses examined if alcohol use varied by event type for both open- and close-ended events. Given previous research demonstrating differences in both typical alcohol use and event-related alcohol use by sex, age, and Greek membership status (e.g., Neighbors et al., 2011; Reich et al., 2015), we also conducted exploratory analyses to determine if event endorsement varied by these individual-level variables. Further, we included these variables in the predictive models as covariates, in addition to race/ethnicity, for statistical control.

Methods

Participants and Procedures

A total of 1067 students randomly selected from a list provided by the university's registrar were emailed an invitation to the parent study. A total of 250 participants completed the screening assessment for the parent study; once this target N was reached recruitment was halted. Participants were removed from analyses for the current study if they were abstinent from alcohol use ($n = 20$) or did not provide information on HRDEs ($n = 26$). The final sample size for the current study is 204. Participants ranged in age from 18 to 24 (Mage = 20.10, $SD = 1.29$). Participants primarily identified as women (n = 128; 62.75%), with the remainder identifying as the following: Men (n = 72; 35.29%), genderqueer/gender non-conforming (n = 3; 1.47%); and gender not listed here (n = 1; 0.49%). Reported biological sex was 74 males (36.27%) and 129 females (63.24%). Participants ethnoracially self-identified as follows: non-Hispanic/Latinx (NH)-White/Caucasian (n = 95, 46.8%), NH Asian/Asian American (n = 73; 35.96%), Hispanic/Latinx (n = 14; 6.9%), NH Multiracial (n = 15; 7.39%), NH Black/African American (n = 3; 1.48%), Other (n = 2; 0.99%), and NH American Indian/Alaskan Native (n = 1; 0.49%). Although there were additional racial and ethnic categories reported by participants (e.g., White and Native American; White and Sephardi Jew), given the variability in the responses participants endorsed in

the text response of the Other category, combined with the small number of endorsements, those self-identifications were combined into one category of “Other or Multiracial” with some of the least endorsed racial categories (i.e., American Indian/Alaskan Native; Black/African American; Hispanic/Latinx) for analytic purposes (i.e., Other or Multiracial, n = 35; 17.24%). All data were collected from June 2018 to the first week of August 2018. All measures and procedures were reviewed and approved by the local human subjects’ review committee.

Measures

Demographics—Participants were asked to report on their biological sex, gender, age, race, ethnicity, and Greek membership status. Due to biological differences in the effects of alcohol, biological sex (0 = Male; 1= Female), and not gender, was utilized in analyses. Age was dichotomized to under 21 (0) and 21 and older (1) to capture whether a participant was of legal drinking age. Racial and ethnic identity was recoded as White/Caucasian, Asian/Asian American, and Other or Multiracial as described above. Individuals who were not currently in Greek membership nor planning to join were coded as non-Greek (0) and individuals who were currently or planning to be involved in a Fraternity or Sorority were coded as Greek (1).

Closed-Ended High-Risk Drinking Events—Based on previous research and pilot data, 9 HRDE were chosen for participants to respond to: New Year’s Eve, Apple Cup (a regional college football game), Halloween, 4th of July, birthday celebration (for participants’ most recent birthday), the day participants drank the most during Spring Break, Memorial Day, end of Finals Week, and St. Patrick’s Day. Participants were instructed to select the number of drinks (from 0 to “25 or more”) for each event, thinking of their most recent occasion of each event (see Table 3). Participants were directed to define one drink as 12 oz. of beer, 8 oz. of Canadian, malt liquor or ice beers, 10 oz. of microbrew, 10 oz. of wine cooler, 4 oz. of wine, or a cocktail with 1 oz. of 100 proof liquor or 1 ¼ oz. Of 80 proof liquor (Wechsler et al., 2002) for all items assessing number of drinks.

Open-ended High-Risk Drinking Events—Participants were asked to list up to “five events where you drank more alcohol than you normally would and how many drinks you had”. Participants typed in their own response for the 5 events and selected the number of drinks using response options “0 drinks” to “25 or more drinks”.

Typical Drinking—Typical drinking (Dimeff et al., 1999) was assessed with the item “On a given occasion during the past month, how much alcohol did you typically drink”. Response options ranged from 0 to “25 or more,” (M = 2.81, SD = 2.90).

Data Analytic Plan

Qualitative Coding of Open-Ended Events—Participants self-identified a total of 611 drinking events in the open-ended responses. In order to examine these open-ended events, the first and second author of the paper used open-coding and then discussed the similarities and dissimilarities between the events listed by participants. After examining the events, we developed a coding scheme to classify the events based on distinct characteristics and

features of the event (e.g., location, type of event, people) in order to categorize events by themes. Most events were able to be categorized based on similarity or dissimilarity to other events (e.g., celebration events; school-related events); however, there were some that were not able to be categorized either due to lack of information (e.g., dorms) or because the event did not have enough similarity with any other event (e.g., end of hackathon). Further, some events had too few endorsements to be meaningfully interpreted (e.g., work party, n = 6) and thus, were left in a not categorized group. Once categories were defined, we then verified accuracy by comparing the events to the categories (Glaser, 1992). The coding procedure was reviewed by the first two authors and the senior author on the paper. This resulted in 24 distinct event codes (See Table 1). Although the 24 distinct categories presented rich, idiosyncratic information, in order to conduct comparison analyses across demographics, the 24 distinct event codes were further collapsed into 11 larger event categories based on similarity of event type and specificity of event detail provided by the participant, (see Table 2). For example, Spring Break remained its own event category as it is not a recognized holiday and has a high level of specificity (i.e., “Spring Break” must have been in the response from the participant for the response to be coded into the Spring Break category). Conversely, although the various responses to birthday indicate some slight specificity in event (e.g., my birthday, friend’s birthday, or simply “birthday”), the events are still similar enough for an overarching theme to emerge into which the more nuanced categories could be collapsed.

Descriptive Analyses of High-Risk Drinking Events—For both the closed-ended events and open-ended event codes and categories we calculated the mean, frequency, and range of the number of drinks consumed. As previous research has indicated that biological sex, age, and Greek membership affect event-specific drinking of researcher-identified events (e.g., Neighbors et al., 2011; Reich et al., 2015), we first assessed if endorsement of both open-ended and closed-ended events differed by biological sex, age, and Greek membership. For this set of exploratory analyses, chi-square analyses were conducted separately for the open-ended category endorsement and the closed-ended events. Due to the number of chi-square assessments conducted, adjusted p-values were used based on the Benjamini-Hochberg adjustment (Benjamini & Hochberg, 1995).

Differences Between Typical Drinking and HRDE—To examine if drinking during HRDE was significantly different than participants’ typical drinking, we used two modeling strategies based on the distribution characteristics. For both models we had events nested within individuals and treated participant reports of typical drinking as the reference event that was compared to the other HRDE. For the closed-ended HRDE, the outcome was count-based and zero-inflated. Therefore, we used a multilevel zero-inflated negative binomial regression in R version 4.1.1 using the glmmTMB package (Brooks et al., 2017). For the open-ended model, since participants reported on events they personally drank the most on, the data did not have a preponderance of zeroes and we therefore utilized a negative binomial multilevel model using glmmTMB package in R. A zero truncated model was not used since some participants did report “0” drinks for their typical drinks. Since the open-ended event categories provided a larger number of events with more missing data (due to the variability between student responses), we compared typical drinking to the

top four most-endorsed event categories, as well as compared these events to each other. Additionally, as previous research has demonstrated differences in typical versus holiday drinking by sex and Greek membership (e.g., Neighbors et al., 2011) we included both of these as covariates in the models. The models also included the dichotomized age variable since our sample included student both at and below the legal drinking age.

Results

Descriptive Analyses

Table 1 provides the full list and description of the 24 event codes from student responses along with the number of students who endorsed each event and the respective means, standard deviations, and ranges for number of drinks consumed. Table 2 provides similar statistics for the collapsed event categories. The variability in the open-ended responses indicated a range of specificity of the events. For example, an event code designated parties with outdoor activities (e.g., “a BBQ”, and “a Beach Party”) from parties that had distinct indoor activities (e.g., “Game night with friends”, and “Dinner party”) because of the level of specificity that students provided about the parties or events. Conversely, a number of responses were provided with no additional information of the type of party or its activities (e.g., “partying with friends” and “house party”) and therefore were coded with the more general event code of “Parties”. Some students also provided responses that were similar to parties, in that they involved getting together with friends, but the language used indicated it was a more laid-back gathering such as “hanging out” and “kickback.” As such, these were given a separate code of “Hang-out/get-together”. When collapsing into categories it was decided these four types of events were sufficiently similar in type to put under the category of “Parties and Get-togethers”. Many students listed a party or event for a specific type of celebration such as a wedding, graduation, reunion or housewarming and these were coded separately as “Celebrations”. Celebrations was kept as its own category during thematic coding due to the number of responses and the unique specificity compared to Parties and Get-togethers. Separate event codes were provided for all responses that matched onto the 9 closed-ended event questions (e.g., New Year’s Eve, Finals). Participants also provided responses for holidays, school-related events, and football-related events other than the ones listed in the closed-ended event questions. Birthdays, both the participant’s own birthday and others’ birthdays, were a common response. Other unique codes that emerged were music-related events, travel/vacation-related events, events with family, and miscellaneous (i.e., events that did not fall into the 24 event codes or that did not have sufficient detail).

Table 3 provides means, standard deviations, and ranges for number of drinks consumed for the closed-ended HRDE questions. All participants answered these questions, therefore the n’s indicate the number of students who reported 1 or more drinks. Since participants could report having no (zero) drinks on the events, Table 3 provides separate statistics for all responses as well as only for students who reported 1 or more drinks. These closed-ended questions provide unique information from the open-ended response. For example, while only a few students reported 4th of July as a higher-drinking event in the open-ended responses, more than half of students reported drinking on 4th of July. Overall, average reported consumption is lower for the closed-ended events compared to the open-ended

events, even when only comparing the events for participants who reported at least 1 drink. Importantly, however, average consumption during the closed-ended drinking events still approached or exceeded HED criteria, with the exception of Memorial Day.

Chi-square analyses that assessed differences of endorsement (i.e., reporting one or more drinks) of the closed-ended event categories by sex indicated no differences between males and females. Students who were 21 and older had a higher percentage endorsing drinking on their birthday than students who were under 21 (88.0% vs 48.1%; χ^2 (1, N = 204) = 32.36, $p < .01$). No other differences were observed regarding age for closed-ended events. Students currently or planning to be Greek members had significantly higher percentages of drinking on Apple Cup (60.8% vs 25.7%) and 4th of July (76.5% vs 50.0%) compared to students who were not Greek members (χ^2 (1, N = 203) = 20.86, $p < .01$, χ^2(1, N = 203) = 10.90, $p < .05$, respectively). Chi-square analyses assessing differences in endorsement of the open-ended questions revealed no significant differences dependent on sex or Greek membership on the 11 event categories. Compared to students who were under 21, students 21+ had a higher proportion endorsing Miscellaneous (8.5% vs 28.0%) as events during which they drank more than what is normal for them (χ^2 (1, N = 204) = 13.60, $p < .05$). Conversely, students who were under 21 had a higher proportion endorsing Parties & Get-togethers (63.6 % vs 36.0%; χ^2 (1, N = 204) = 14.48, $p < .01$).

Exploratory predictive analyses

Estimates from the negative binomial zero-inflated regression that compared closed-ended events to typical drinking are in Table 4. Results indicated that compared to a typical drinking event, participants reported drinking more on 1) their birthday, 2) New Year's Eve, 3) Halloween, 4) Finals, and 5) Spring Break. Interestingly, participants reported drinking *less* than their typical drinking on St. Patrick's Day and Memorial Day. No significant differences were observed for 4th of July or Apple Cup. An examination of the covariates revealed students with Greek membership reported drinking more on events than students without Greek membership.

The original planned negative binomial regression that examined if drinking within the open-ended drinking events differed from participants' typical drinking and included all covariates had difficulties converging. Therefore, we ran models separately with each covariate; minimal differences were detected in the models. Age and sex were not significant predictors when assessed independently, and therefore were trimmed from the overall model. The final model included covariates that were significant (i.e., Greek membership and race) and had no convergence errors (Table 5). Results indicated that among all four event categories assessed, participants drank significantly more than their typical drinking event. Similar to the closed-ended model, students with Greek membership reported drinking more on events than students without Greek membership.

In addition to examining how drinking quantity varied compared to typical drinking in both open- and closed-ended events, we also compared drinking quantity between types of events. Among the close-ended events, participants' own birthday, New Year's Eve, and Spring Break had significantly greater drinking than four of the other eight events including St. Patrick's Day, 4th of July, Memorial Day, and Apple Cup (see Table 6 for summary of

significant differences and Supplementary Table 1 for model estimates). Additionally, 4th of July, Halloween, Finals, and Apple Cup all had significantly greater drinking means than St. Patrick's Day and Memorial Day. When examining the open-ended event comparisons, all comparisons across events were nonsignificant (see Supplementary Table 2).

Discussion

The current paper highlights what previous studies have demonstrated—the complexity in the conceptualization of a "high-risk drinking event" (HRDE). The mixed-methods approach elucidated that, while calendar-based events (e.g., New Year's Eve, birthdays) are still important regarding college student drinking, what constitutes a HRDE can involve several factors, including physical characteristics, actors, reasons for gathering, and/or timing. Therefore, events are not always static targets (e.g., 21st birthdays) but represent shifting, dynamic points of intervention. Past research has differentiated events into *community events* and *personal events,* with community events experienced by students simultaneously, such as a holiday or national sporting event, and personal events experienced at different times, such as a 21st birthday (Neighbors et al., 2007). The current findings support this delineation but further suggest that students' individual high-risk drinking events may both be highly personalized and specific to them (e.g., role playing game) as well as categorized as more general events (e.g., party).

From students' open-ended responses of events during which they drank more than what is typical for them, interpretations can be made on the similarities, specificity, and range of HRDE. Overall, birthdays (including students' own birthdays, others' birthdays, 21st birthdays, and non-specific birthdays) pose an increased risk for drinking more than an individuals' typical amount, as do Celebrations, Parties and Get-togethers, and Holidays; however, these events did not significantly differ from each other in amount of drinks consumed during these events in the comparative analyses. While these categories may seem broad, it is important to remember that they comprise events students nominated themselves and the number of students endorsing the events varies (e.g., Parties/Get Togethers n = 109; Celebrations n = 44). For example, within the category Parties and Get-togethers, many open-ended responses may indicate smaller gatherings and not necessarily the large parties often envisioned when a "college party" is referenced. More research is needed to understand if these events represent fundamentally different risk profiles (e.g., hangouts versus parties versus kickbacks) and nuances that potentially differentiate them. Additionally, responses to the open-ended questions evidenced high levels of specificity in the labels and qualifying words that students used to describe their events (e.g., outside party; the Bachelor finale; Drunk Smash Brothers Tournament; playing Dungeons and Dragons). These findings highlight the importance of considering person and context interactions and more research is needed to determine if there are important between-person differences among students who provide a high level of specificity versus those who do not, and how this specificity impacts their drinking during the events they list.

These results show that what constitutes a HRDE for one individual may not hold for another. Past research has shown individuals who drink have preferred drinking venues and events which vary across individuals and support these potential individual contexts

of risk (Mubayi et al., 2011). When conceptualizing interventions for college student drinking at the individual level, having unique specificity of events may allow important person-centered tailoring. In fact, research on college student brief interventions suggests the more personalized the material, the greater impact on drinking behaviors an intervention may have (Ray et al., 2014). Having students provide information about previous HRDE may allow for tailored timing and context of intervention materials. Ecological momentary interventions (EMIs) aim to provide intervention material in real-time within participants' natural environment and are typically delivered through text or mobile applications (Heron & Smyth, 2011). EMIs directed at college student HRDE could be tailored to the specific events that each student reports as being of risk previously. This adaptation of EMIs for HRDE is partially supported by findings indicating a text-message based intervention provided prior to tailgating at a football game was associated with reduced drinking during the tailgate and a lower peak BAC a month later (Cadigan et al., 2019). Normative feedback interventions for college drinking work to correct misperceived norms that students typically have about other students' drinking behaviors (Agostinelli et al.,1995). Normative feedback interventions are effective at reducing student drinking generally but have had mixed effects for specific events (Buckner et al., 2019; Lewis et al., 2008; Patrick et al., 2014). The current research suggests a potential avenue for further development is to expand and tailor feedback to HRDE that are unique to each student. Additional research is needed to assess the feasibility of targeting person-specific HRDE and whether providing normative feedback or other empirically supported feedback components particular to these events has a greater effect than feedback for general drinking or all calendar-based events.

A potential avenue to provide tailored feedback for HRDE is the use of both machines learning and Dynamic Treatment Regimes and Adaptive Interventions (Chakraborty & Murphy, 2014). Research in alcohol use and risky drinking has already started to delve into these areas using longitudinal data and been able to predict risk factors associated with drinking (Bi et al., 2013). Further, preliminary research has utilized sensor data from young adults' cell phones to detect high risk drinking environments (Bae et al., 2018). Combining knowledge reported by participants about their own events with sensor data has the potential to possibly produce dynamic just-in-time adaptive interventions. Therefore, nuanced feedback and intervention may be feasible through the use of technology. While this area is growing, it is still underdeveloped and more research is needed to determine feasibility and algorithm development.

While HRDE may be highly individualized, the current research also supports past research that found drinking events may also be subject to regional- and campus-specific differences or be more pronounced among specific groups on campus, such as Greek members (Henslee et al., 2015; Neighbors et al., 2007; 2011). For example, while students in the current study reported drinking less than their typical amount on St. Patrick's Day, this has not been shown in previous research in other areas of the United States (Tremblay et al., 2010). Further, comparison analyses of the close ended-events demonstrated St. Patrick's Day drinking was less than all other closed-ended events except Memorial Day, with no significant difference between these two events. It is notable that St. Patrick's Day during the data collection window for this study occurred on the university's first day of Spring Break, possibly indicating the unique high-risk environment of St. Patrick's Day may only

occur for college students if they experience it on campus. On another campus, due to St. Patrick's Day occurring during Spring Break, students created a replacement holiday (i.e., "State Patty's Day"), and had greater odds of heavy drinking on this "holiday" compared to other weekend days (Lefkowitz et al., 2012). Alternatively, for students in the current study, the events and activities related to Spring Break may trump those of St. Patrick's Day, and drinking on St. Patrick's Day (i.e., drinking on March 17th) may have only been associated with drinking during Spring Break. Together, these results suggest HRDE may be best explained through a social-ecological approach where events may occur from influences at different hierarchical levels such as shared calendar-based events in society (e.g., New Year's Eve), regional-, community-, and campus-specific events, and individually reported events. As such, while open-ended and closed-ended assessments both have important application for assessing HRDE, researchers, clinicians and campuses should consider including at least one open-ended question when examining HRDE.

Findings also indicated noteworthy differences between the number of students endorsing drinking at an event versus the amount of alcohol consumed. Specifically, two types of drinking events emerged; events that are endorsed by more students, and events where more drinks are consumed. For example, the highest endorsed event categories were Parties and Get-togethers, birthdays, and holidays; however, some of the event categories with the lowest percentage of endorsement had the highest average number of drinks consumed (i.e., Football games, Spring Break). It is important to note that from the open-ended responses the average drinks consumed exceeded heavy episodic drinking levels (i.e., 4+/5+ drinks in 2 hours for women/men; NIAAA, 2018) for all 24 idiosyncratic event codes and 11 collapsed event categories. However, the range of the number of drinks indicated not every student who endorsed each event engaged in high-risk drinking. In fact, for many of the events, some students reported 1 or 2 drinks. These two types of HRDE may be relevant for different types of intervention efforts. For example, public health approaches that include community and campus-wide efforts may wish to focus on events where a larger number of students endorse drinking. Since these efforts are likely to reach a greater number of students, focusing on these types of HRDE may provide the maximum overall impact. These more universal approaches may also work to prevent students who engage in low-risk drinking from transitioning to heavier drinking. Conversely, group and individual interventions may be more impactful incorporating tailored approaches that focus on events during which specific groups or individual students report higher levels of drinking.

Limitations and Future Directions

Although the current study utilized a mixed-method approach to examining HRDE, no study is without limitations. The current study utilizes cross-sectional data from a sample that was primarily White/Caucasian with a higher percentage of Asian/ Asian-American participants and women participants than the overall student population at this campus (e.g., 36.27% vs. 21.3% for Asian/Asian-American, 63.24% vs 53.7% for women). Further, these data were collected from a single university and response rate was low (partially due to recruitment being limited to 250 respondents during a very brief recruitment window; higher response rates would have been achieved if the recruitment window had remained open), calling into question the generalizability of the findings. Future work should replicate our findings

with larger more diverse samples. The study found a number of self-reported HRDE that could not be neatly categorized (i.e., miscellaneous) which is supportive of the diversity of HRDE experiences and of the importance of future research in continuing to identify them. As there was diversity in the level of detail of responses from students, it is also important for future research to delineate how much specificity is needed (e.g., type of party versus party generally) or what aspects (e.g., friend's birthday versus random party; during orientation week versus related to school generally) are relevant for prevention and intervention efforts. Further, comparisons of drinking reported during the open-ended events are limited to including participants who listed those events. Thus, comparisons do not include participants who may have consumed alcohol during the other events, but did not list them due to being limited to five events. Additionally, as this study was retrospective, there may have been recall bias in that students may have remembered more events that were closer to their assessment, or do not have as accurate recall of how much they drank on the events that happened further in the past. Therefore, it is important for future research to use intensive longitudinal data collection methods to remedy possible issues related to retrospective bias.

Conclusions

Despite the current study's limitations, utilizing a mixed-methods approach to understanding HRDE allowed us to gain further understanding of HRDEs than is available from a more traditional calendar-based approach. Findings highlight important avenues for both research and clinical work. Results are consistent with previous assessments that predominately utilized first-year college students, suggesting many of the previously researched HRDE remain relevant for older college students. However, results also suggest HRDE are complex, highly individualized, and range from very specific to more general. Clinicians and health providers working with young adults experiencing issues with alcohol may benefit from asking them to list events during which they drank more than their typical amount as both a starting point to discuss potential high-risk contexts, and a possible avenue to provide appropriate intervention and treatment approaches. As is suggested by NIAAA (2019), campuses and communities may benefit by working together in creating an intervention approach that targets HRDE with both environmental strategies, such as restricting happy hour promotions (Kuo et al., 2003) during calendar-based HRDE, and individual strategies, such as brief motivational interventions and normative feedback that may be tailored using EMIs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Codes, Descriptions, Percent Endorsement of Drinking, and Descriptives of Drinks Consumed for All Drinking Events from Open-Ended Questions

	Description	*n*	%	Mean	*SD*	Min	Max
Friend's Birthday	Participant's friend's birthday	57	27.94	6.51	2.95	1.00	17.00
Other Parties	Parties that have another type of specification other than an indoor or outdoor area (e.g., Game night), or have no specifications (e.g., Party)	49	24.02	6.45	2.71	1.00	13.00
Celebrations	Parties or get-togethers for a specific celebration (e.g., Wedding, Housewarming party)	44	21.57	6.48	3.29	1.00	15.00
Other Birthday	Birthday of someone else other than the participant or a friend (e.g., sibling) or no designation of relationship to who's birthday it is (e.g., birthday)	32	15.69	7.03	4.05	1.00	17.00
Miscellaneous	Uncategorized events (e.g., Night out, Dorms, Friday night)	32	15.69	6.32	2.93	2.00	14.00
Greek Life	Events surrounding Greek Life	31	15.20	7.98	4.26	1.00	21.00
Hangouts	Hangout, chill, get-togethers, kickbacks	28	13.73	6.01	3.09	1.00	12.00
Other School	Events other than Finals related to the academic calendar or school related events (e.g., Syllabus Week, after midterms)	26	12.75	7.42	4.22	1.00	15.00
New Year's Eve	New Year's Eve	25	12.25	6.34	3.22	1.00	16.00
Music Events	Events specific to music (e.g., music festival, concert)	22	10.78	6.75	1.89	4.00	10.00
Travel/Study Abroad	Events related to traveling, including studying abroad	21	10.29	7.07	3.42	2.00	14.00
Indoor Parties	Parties that have a specified indoor location or activity (e.g., Dinner party, game night)	18	8.82	5.39	2.91	1.00	11.00
Family Events	Events with family members (e.g., family reunion)	15	7.35	5.60	2.87	1.00	10.00
Outdoor Parties	Parties that have a specified outdoor location or activity (e.g., camping)	14	6.86	5.21	1.58	4.00	9.00
My Birthday	Participant's own birthday	13	6.37	8.54	5.08	3.00	20.00
Football	Events related to football games	13	6.37	7.38	3.15	4.00	14.00
Finals	Finals or finals week	12	5.88	7.67	3.65	2.00	14.00
Halloween	Halloween or Halloween party	11	5.39	8.18	3.46	3.00	15.00
Fourth of July	Fourth of July	9	4.41	6.89	4.17	3.00	15.00
Other Holidays	A holiday other than the ones listed (e.g., Chinese New Year)	7	3.43	5.71	2.43	3.00	9.00
Spring Break	Spring Break	7	3.43	8.71	3.20	5.00	15.00
St. Patrick's Day	St. Patrick's Day	1	0.49	6.00	0.00	6.00	6.00
Memorial Day	Memorial Day	1	0.49	10.00	0.00	10.00	10.00
Apple Cup	Apple Cup (Football Rivalry Game)	1	0.49	9.00	0.00	9.00	9.00

Table 2.

Descriptions, Percent Endorsement of Drinking, and Descriptives of Drinks Consumed for Collapsed Drinking Categories for Open-Ended Questions

	Inclusive Event Codes	***n***	**%**	**Mean**	***SD***	**Min**	**Max**
Parties/Get Togethers	Indoor Parties, Outdoor Parties, Other Parties, Hangouts, Greek Life	109	53.43	6.67	3.32	1.00	21.00
Birthdays	My Birthday, Friend's Birthday, Other Birthday	90	44.12	6.84	3.41	1.00	17.00
Holidays	New Year's Eve, St. Patrick's Day, Memorial Day, Fourth of July, Halloween, Other Holidays	46	22.55	7.00	3.37	1.00	16.00
Celebrations		44	21.57	6.48	3.29	1.00	15.00
School Related	Finals, Other School Related	35	17.16	7.67	4.03	1.00	15.00
Miscellaneous		32	15.69	6.32	2.93	2.00	14.00
Music Events		22	10.78	6.75	1.89	4.00	10.00
Travel/Study Abroad		21	10.29	7.07	3.42	2.00	14.00
Family Events		15	7.35	5.60	2.87	1.00	10.00
Football Games	Football, Apple Cup	14	6.86	7.50	3.06	4.00	14.00
Spring Break		7	3.43	8.71	3.20	5.00	15.00

Table 3.

Descriptives for Closed-Ended Events

	Number of Drinks Consumed											
	All Students						Students who Endorsed Drinking at Event					
Event	***n***	**%**	**Mean**	***SD***	**Min**	**Max**	***n***	**%**	**Mean**	***SD***	**Min**	**Max**
New Year's Eve	204	100	3.64	3.56	0.00	20.00	151	74.02	4.92	3.29	1.00	20.00
End of Finals Week	204	100	3.11	3.21	0.00	16.00	140	68.63	4.54	2.92	1.00	16.00
My Birthday	204	100	3.35	4.02	0.00	20.00	128	62.75	5.34	3.89	1.00	20.00
Spring Break	204	100	3.38	4.06	0.00	25.00	127	62.25	5.43	3.92	1.00	25.00
Halloween	204	100	3.11	3.59	0.00	17.00	120	58.82	5.29	3.21	1.00	17.00
4th of July	204	100	2.59	3.30	0.00	17.00	116	56.86	4.55	3.19	1.00	17.00
Apple Cup	204	100	1.80	3.22	0.00	16.00	70	34.31	5.24	3.48	1.00	16.00
St. Patrick's Day	204	100	1.07	2.26	0.00	10.00	52	25.49	4.19	2.63	1.00	10.00
Memorial Day	204	100	0.86	1.95	0.00	11.00	51	25.00	3.43	2.52	1.00	11.00

Note: Descriptives for *All Students* includes students who indicated zero number of drinks at the event. Descriptives for *Students who Endorsed Drinking at Event* only include students who reported 1 or more drinks at each event.

Table 4.

Zero-Inflated Negative Binomial Model Results for Closed-Ended Events

Predictor	Estimate	*SE*	*z*	*p*
Fixed Effects				
Negative Binomial				
Intercept	0.914	0.148	6.177	<.001
Events				
Typical Drinks	REF			
Fourth of July	0.081	0.075	1.085	.277
Memorial Day	−0.693	0.119	−5.821	<.001
My Birthday	0.399	0.071	5.629	<.001
Finals	0.223	0.071	3.161	.002
New Years Eve	0.324	0.068	4.745	<.001
St. Patrick's Day	−0.363	0.113	−3.202	.001
Spring Break	0.377	0.071	5.324	<.001
Apple Cup	0.018	0.09	0.198	.843
Halloween	0.236	0.072	3.274	.001
Age				
Under 21	REF			
21+	−0.019	0.131	−0.147	0.883
Race				
White	REF			
Asian	−0.318	0.141	−2.257	0.024
Racially Diverse	−0.172	0.177	−0.973	0.331
Sex				
Male	REF			
Female	−0.134	0.13	−1.032	0.302
Greek Status				
Non-Greek	REF			
Greek Member	0.628	0.147	4.283	<.001
Zero-Inflation				
Intercept	−0.784	0.073	−10.74	<.001
Random Effects	Variance	SE		
Intercept	0.656	0.81		

Table 5.

Negative Binomial Model Results Predicting Number of Drinks Consumed on Open-Ended Events Compared to Typical Drinking

Predictor	**Estimate**	***SE***	***z***	***p***
Fixed Effects				
Intercept	0.912	0.067	13.514	<.001
Events				
Typical Drinks	REF			
Parties/Get Togethers	0.836	0.056	15.066	<.001
Birthdays	0.824	0.059	13.906	<.001
Holidays	0.866	0.074	11.66	<.001
Celebrations	0.850	0.073	11.601	<.001
Race				
White	REF			
Asian	−0.174	0.078	−2.176	0.174
Racially Diverse	−0.050	0.096	−0.521	0.603
Greek Status				
Non-Greek	REF			
Greek Member	0.403	0.077	5.127	<.001
Random Effects	Variance	SE		
Intercept	0.145	0.381		

Table 6.

Summary of Results from Comparisons of Closed-Ended Events,

	Comparison Event								
Reference Event	**Birthday**	**St. Patrick's Day**	**4th of July**	**NYE**	**Halloween**	**Memorial Day**	**Finals**	**Spring Break**	**Apple Cup**
Birthday		−	−	ns	ns	−	ns	ns	−
St. Patrick's Day	+		+	+	+	ns	+	+	+
4th of July	+	−		+	ns	−	ns	+	ns
New Year's Eve	ns	−	−		ns	−	ns	ns	−
Halloween	ns	−	ns	ns		−	ns	ns	ns
Memorial Day	+	ns	+	+	+		+	+	+
End of Finals Week	ns	−	ns	ns	ns	−		ns	ns
Spring Break	ns	−	−	ns	ns	−	ns		−
Apple Cup	+	−	ns	+	ns	−	ns	+	

Note: Table depicts the direction of comparisons, + indicates the comparison event (columns) is greater than the reference event (rows), − indicates the comparison event is less than the reference event, and *ns* indicates no significant differences between the two events.

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