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Do Alcohol Use Reasons and Contexts Differentiate Adolescent High-Intensity Drinking? Data from US High School Seniors, 2005–2016

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Abstract

The purpose of this study was to examine associations between (a) self-reported reasons for and contexts of alcohol use and (b) high-intensity drinking (i.e., having 10+ drinks in a row in the past two weeks) among national samples of U.S. 12th grade students. Data were obtained from 16,902 students who reported any past 12-month alcohol use from nationally-representative annual 12th grade student samples from 2005–2016. When asked about drinking behavior during the past two weeks, 72% reported consuming less than 5 drinks at most during one drinking occasion; 14% reported 5–9 drinks, 7% reported 10–14 drinks, and 7% reported 15+ drinks. Adolescent drinkers in all categories (<5, 5–9, 10–14, and 15+ drinks) endorsed “to have a good time” as the most prevalent reason for alcohol use, and “at a party” as the most prevalent context of alcohol use. However, high-intensity drinking was particularly likely among adolescents drinking for coping, compulsive use, and drug effect reasons, as well as those who enjoyed the taste. Having 15+ drinks (vs. 10–14 drinks) was particularly associated with compulsive use and enjoying the taste. The relative risk of any high-intensity drinking, and of higher levels of high-intensity drinking involvement, increased with the total number of reasons and contexts endorsed. Alcohol appears to serve a larger number of functions for high-intensity drinking adolescents than non-high-intensity drinking youth.

Keywords

adolescent; high-intensity drinking; alcohol use reasons; alcohol use contexts

In 2015 alone, an estimated 1.4 million U.S. adolescents aged 12–17 consumed alcohol at binge levels in the past 30 days (Center for Behavioral Health Statistics and Quality, 2016), and a meaningful number of adolescents drank at levels two to three times higher than the traditional 5+ binge drinking threshold. Estimates based on nationally representative samples of high school seniors from 2005–2011 showed that approximately 10% reported having 10 or more drinks per occasion and approximately 5% reported having 15 or more drinks (Patrick et al., 2013). Such high levels of alcohol consumption, referred to as high-intensity drinking or HID (Patrick, 2016), are estimated to result in blood-alcohol

concentrations (BACs) 4 to 5 times higher than the 0.08 g/dL level (Hingson & White, 2013) used to define binge drinking among adults (National Institute on Alcohol Abuse and Alcoholism [NIAAA], n.d.). Intoxication at such levels is associated with severe and life-threatening impairment (NIAAA, 2015). While youth who binge drink have a high risk of a range of negative consequences (Centers for Disease Control and Prevention [CDC], 2016), drinking at levels above the traditional binge threshold increases the risk of numerous alcohol-related problems including academic/occupational problems, blackouts, and impaired control (Read, Beattie, Chamberlain, & Merrill, 2008). Young adults reporting HID (especially at the 15+ level) are more likely than others to report they drink at high levels even when experiencing consequences such as violence and arrest (Hingson & White, 2013).

The literature has called for research that can identify predictors of HID with the goal of intervening to prevent such high-risk consumption (Hingson & White, 2013; Patrick, 2016). One area of related inquiry is to examine what motivates such drinking behavior. Research among adolescents (as well as adults) has found that variance in both quantity and frequency of alcohol use can be substantially explained by four motive factors: social, enhancement, coping, and conformity (Cooper, 1994; Cox & Klinger, 1988, 1990). Drinking problems among adolescents have been particularly associated with coping motives (Cooper 1994; Cooper, Frone, Russell, & Mudar, 1995; Kuntsche, Knibbe, Gmel, & Engels, 2005) and, to a lesser extent, conformity motives (Cooper 1994). Enhancement motives have been associated with heavy drinking (Kuntsche et al., 2005). Social motives have been associated with moderate use in some studies (Kuntsche et al, 2005), but with heavy drinking and/or alcohol misuse in others (Bradizza, Reifman, & Barnes, 1999). Based on such research, HID may be particularly associated with coping and enhancement motives.

The particular motive(s) underlying adolescent HID use can be explored by examining self-reported reasons given for drinking. As Patrick and colleagues (Patrick, Schulenberg, O'Malley, Johnston, & Bachman, 2011a) note, social motives include reasons such as drinking to have fun with friends; enhancement motives include drinking to get high; coping motives include reasons like drinking to forget problems; and conformity motives include drinking to fit in. Prior research has shown that self-reported reasons for alcohol use among adolescents are associated significantly with early initiation of alcohol use (Coffman, Patrick, Palen, Rhoades, & Ventura, 2007), current frequency of binge drinking and drunkenness (Coffman et al., 2007; Patrick et al., 2011a), heavier lifetime alcohol use (Johnston & O'Malley, 1986), and long-term risk for alcohol use disorder (Patrick et al., 2011a), and. There is support in the literature for the idea that the total number of reasons endorsed for alcohol use (regardless of the types of underlying motives) is positively and significantly associated with level of drinking involvement (Coffman et al., 2007; Johnston & O'Malley, 1986; Kuntsche et al., 2005).

Two studies have examined associations between reasons for alcohol use and HID. White and colleagues (2016) examined reasons and HID behaviors in a college student sample. Students reporting HID also reported higher endorsement of reasons associated with social, enhancement, and coping motives than both non-binge and binge drinkers (White, Anderson, Ray, & Mun, 2016). Six-month changes in HID participation were associated with specific patterns of change in drinking motives: movement from non-HID to HID

drinking was associated with increased social and enhancement motives, while movement from HID to lower levels of drinking was associated with reductions in enhancement and coping motives (White et al., 2016). Patrick and colleagues (Patrick, Evans-Polce, Kloska, Maggs, & Lanza, in press) examined age-related changes in the direction and magnitude of associations between eight specific drinking reasons and HID among a national sample of past 12-month alcohol users aged 18 through 26. At age 18, each of the eight reasons individually examined (anger/frustration; boredom; get away from problems/troubles; feel good/get high; have a good time; relax/relieve tension; sleep; tastes good) was associated with higher odds of HID among all alcohol users; however, only anger/frustration significantly differentiated HID and binge drinking at age 18 (Patrick et al., in press). The Patrick et al. study controlled for important covariates, but examined only one reason at a time. To the authors' knowledge, research that (a) compares association strength between a range of alcohol use reasons and adolescent HID, and/or (b) investigates if adolescent HID is differentiated from lower levels of alcohol consumption simply by the reasons endorsed has not been available.

Motives underlying alcohol use behaviors also are significantly associated with alcohol use contexts (Cooper, 1994), and research finds that context (physical location, time of day, or social setting) differentiates adolescent drinking (Plant, Bagnall, & Foster, 1990). Cooper (1994) found that each of the four main drinking motives was associated with specific patterns of context-dependent alcohol use among adolescents: social and conformity motives were associated with drinking at parties, enhancement motives with drinking at bars, and coping motives with drinking at home and alone. The overwhelming majority of high school students who report drinking while driving (i.e., in a vehicle) also report binge drinking (CDC, 2012). Adolescent solitary drinking is associated with higher consumption levels and later development of alcohol problems in young adulthood (Creswell, Chung, Clark, & Martin, 2014), and drinking during the day is a recognized high-risk drinking behavior (Coffman et al., 2007). Coffman et al. (2007) found that adolescents who drank primarily to experiment were the least likely to drink before 4:00pm, while those who endorsed reasons representing several motives were the most likely to drink during the day. Based such research, adolescent HID may be particularly associated with vehicles, drinking during the day, and drinking alone. However, among a college student sample, the likelihood of any HID was significantly higher during weekends (vs. weekdays) and drinking at a party (vs. alone) (Patrick, Crouce, Fairlie, Atkins, & Lee, 2016). To the authors' knowledge, contexts for alcohol use have not yet been examined for their ability to differentiate adolescent HID.

Research has identified several key covariates associated with adolescent HID; analyses examining associations between drinking reasons and contexts and adolescent HID should account for these important associations. In regards to sociodemographic predictors, the likelihood of adolescent HID has been shown to be significantly higher for boys (vs. girls), white adolescents (vs. Black or non-Hispanic adolescents), youth whose parents have higher education, and adolescents living in the South (vs. Northeast or West) and in rural areas (vs. urban) (Patrick et al., 2013). Further, the likelihood of adolescent HID varies based on school-related and social measures. Higher school truancy, evenings out with friends, and perceived number of friends who get drunk weekly are all associated with higher odds of HID (Patrick et al., 2013).

Purpose

The current study aims to contribute to the literature on adolescent HID by using data from nationally-representative samples of US 12th grade students from 2005–2016 to examine if drinking reasons and contexts differentiate adolescent HID from lower levels of drinking, and/or differentiate between HID levels. After limiting the sample to only 12th grade students reporting any past 12-month alcohol use, four research aims were developed to answer the primary research question:

1. Compare ranking of drinking reasons and contexts by drinking category (defined as <5 drinks within the past 2 weeks, 5–9 drinks, 10–14 drinks, and 15+ drinks).
2. Compare (a) endorsement prevalence of individual reasons and contexts, as well as (b) total number of reasons and contexts endorsed, by drinking category.
3. Within a multivariable context, examine the strength of association between (a) separate reasons/contextes (controlling for all other reasons/contextes) and drinking category, and (b) the total number of reasons/contextes and drinking category.

Method

Sample

Analyses utilized data from the national cohort-sequential Monitoring the Future (MTF) study (for detailed methods, see Bachman, Johnston, O'Malley, Schulenberg, & Miech, 2015; Miech, Johnston, O'Malley, Bachman, & Schulenberg, 2016). MTF annually surveys nationally-representative samples of approximately 15,000 12th grade students (modal age 18) from approximately 130 schools. Students usually complete the survey during a high school class period. The University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board approved the study.

The MTF study has collected data on HID since 2005; thus, this analysis included cases from 2005 through 2016. The average 12th grade student response rate for these years was 82.1% (the majority of non-response was due to absenteeism; less than 1.7% of students refused participation) (Miech et al., 2016). To increase the range of measures included in the MTF survey but not overburden respondents, six different questionnaire forms (randomly distributed) are used in the study. Questions on both HID and alcohol use reasons/contextes are included on only one form. Reasons and context measures for alcohol use were only relevant for students who reported any past 12-month alcohol use. Of the 28,602 12th grade students who responded to the relevant MTF survey form during 2005–2016, 18,383 reported past 12-month alcohol use (missing data for this measure were observed for 1,462 students, or 5.1%). Of the 18,383 cases, 17,575 (95.6%) had valid data on measures needed to code drinking category. After removing additional cases with missing data on reasons and contexts for alcohol use, the final analytic sample included 16,902 students (48% male and 64% White), or 91.9% of the possible 18,383 respondents.

Measures

Drinking categories—These analyses examined four drinking categories among students who reported any past 12-month alcohol use using the following question format: “During the last two weeks, how many times (if any) have you had [*specified number of drinks*] or more in a row?” The three specified numbers of drinks were “five,” “10,” and “15” drinks. Response options included “none,” “once,” “twice,” “three to five times,” “six to nine times,” and “ten or more times.” Responses for each individual were recoded into a single four-level categorical measure identifying the maximum number of drinks per occasion reported in the past two weeks: < 5 drinks (0), 5–9 drinks (1), 10–14 drinks (2), 15+ drinks (3). (See Supplement Appendix for original question text; additional references for the 10+ and 15+ drinking items include Patrick et al., 2013; Patrick & Terry-McElrath, 2017; Patrick, Terry-McElrath, Kloska, & Schulenberg, 2016.)

Reasons—Reasons for drinking were asked using the following question: “What have been the most important reasons for your drinking alcoholic beverages?” Fifteen response options followed (respondents were instructed to mark all that applied), including “To have a good time with my friends,” “To experiment – to see what it’s like,” “To relax or relieve tension,” “Because it tastes good,” “To feel good or get high,” “To get away from my problems or troubles,” “Because of boredom, nothing else to do,” “Because of anger or frustration,” “To get to sleep,” “To fit in with a group I like,” “To seek deeper insights and understanding,” “To increase the effects of some other drug(s),” “To get through the day,” “Because I am ‘hooked’ – I feel I have to drink,” and “To decrease (offset) the effect of some other drug(s).” For each reason, a dichotomy was coded to indicate endorsement (1) versus no endorsement (0).

MTF measures on reasons for drinking were designed to capture a broad range of reasons for alcohol use within a national survey (Patrick et al., 2011a). Given that the measures have been asked since 1976, they were not designed to specifically reflect the four social, enhancement, coping and conformity motive factors identified by later research (Cooper, 1994; Cox & Klinger, 1988). However, as has been done in prior publications (Patrick et al., 2011a; Terry-McElrath et al., 2009), they can be grouped meaningfully as follows: social/recreational reasons (to have a good time; to experiment; to get high; because of boredom; to fit in); coping with negative affect reasons (to relax; to get away from problems; because of anger/frustration); compulsive use reasons (to get through the day; hooked) drug effect reasons (to increase effects of other drugs; to decrease effects of other drugs); and miscellaneous reasons (taste; to sleep; to seek insights/understanding).

Contexts—Drinking contexts were asked using the following question: “When you used alcohol during the last year, how often did you use it in each of the following situations? ... At a party; ... During the daytime (before 4:00 p.m.); ... In a car; ... When you were alone; ... At school.” Response options included, “Not at all,” “A few of the times,” “Some of the times,” “Most of the times,” and “Every time.” In order to be consistent with the dichotomous measures of drinking reasons, a dichotomy of ever (1) versus never (0) was coded for each context for analysis.

Covariates—All covariates excluding urbanicity and region were self-reported. Gender was coded as male or female (referent). Race/ethnicity was coded as White (referent), Black, Hispanic, or Other. Parent education (used as a proxy for socioeconomic status) indicated whether some college education had been obtained by one or more parents versus neither parent (referent). Average high school grades were measured on a 9-point scale ranging from D to A. Truancy was measured using the question, “During the last four weeks, how many whole days of school have you missed because you skipped or ‘cut’?” Responses used a scale of 1 (none) to 7 (11 or more days). A question about evenings out was asked as, “During a typical week, on how many evenings do you go out for fun and recreation?” Responses used a scale of 1 (less than one) to 6 (six or seven evenings). Number of friends who get drunk was measured using the question, “How many of your friends would you estimate get drunk at least once a week?” Responses used a scale of 1 (none) to 5 (all). Urbanicity was coded as rural, suburban, or urban (referent). Region was coded as Midwest, Northeast, West, or South (referent). Year was included using both linear and quadratic terms (centered on 2010). Variable amounts of missing data were present for covariates (other than urbanicity and region, which had no missing data), ranging from 6.0% (friends drunk) to 11.6% (evenings out).

Analysis

All analyses accounted for the MTF complex sample design and included weights to account for differential probability of selection. Using SAS version 9.4, PROC SURVEYFREQ and PROC SURVEYMEANS were used to estimate overall descriptive statistics and the prevalence of reason/context endorsement by drinking category. Using Mplus version 7.4, multivariable multinomial logistic regression models (using the MLR estimator and Montecarlo integration) were fit regressing drinking category simultaneously on (1) individual reasons, individual contexts, and covariates; and then on (2) total number of reasons, total number of contexts, and covariates. Multinomial regression models first used 5–9 drinks as the base class to examine how reason/context endorsement was associated with the likelihood of both non-binge drinking (< 5) and HID (10–14 and 15+ drinks) versus 5–9 drinking. The regression models were then repeated using 15+ drinks as the base class in order to examine how reason/context endorsement was associated with the likelihood of different HID levels (10–14 drinks vs. 15+ drinks). Mplus utilizes full information maximum likelihood estimation, and thus uses all available data (Arbuckle, 1996; Enders, 2001). Missing data on covariates were addressed by including covariates in the model via modeling covariate variances (Muthén & Muthén, 2010).

Results

Descriptive Statistics

Table 1 presents descriptive statistics for drinking categories and covariates for 2005–2016 combined. Among this sample of 12th grade students reporting any past 12-month alcohol use, almost two-thirds (72%) reported engaging in <5 drinks as the highest level of per-occasion use in the past two weeks. Among past-year drinkers, 14% of respondents consumed 5–9 drinks, 7% consumed 10–14 drinks, and 7% consumed 15+ drinks.

Research Aim (RA) 1: Ranking comparison of drinking reasons and contexts by drinking category

Table 2 shows weighted percentages of all respondents who endorsed each reason and context for alcohol use, as well as the percentage of respondents who endorsed each reason or context by drinking category. Reasons and contexts are listed in descending rank order of endorsement among the overall sample.

Reasons—Overall, the most commonly endorsed reason was using alcohol to have a good time (73% of all respondents), followed by using alcohol to experiment (52%) and to relax (42%). Following those three reasons, between 21% and 36% of all respondents endorsed using alcohol because it tastes good, to get high, to get away from problems, or because of boredom. Thirteen percent of all respondents endorsed using alcohol because of anger. Less than 10% of all respondents endorsed the remaining reasons. In looking at the rank order of reason endorsement by drinking category, both similarities and differences were observed. The top reason for all categories was drinking to have a good time. The rank order of endorsement for the remaining reasons was generally the same for respondents who reported <5 drinks as for all respondents combined. For 5–9, 10–14, and 15+ drinkers, the second and/or third reasons included to relax and to get high. For 5–9 drinkers, these reasons were followed by using alcohol to experiment and because it tastes good. The same two reasons followed for 10–14 drinkers, but in reverse order. For 15+ drinkers, the top three reasons were followed by using alcohol because it tastes good and to get away from problems. The rank ordering of most of the remaining reasons was generally similar across the 5–9, 10–14, and 15+ drinking categories, with one clear exception: the rank order of the reason “to increase the effects of some other drug(s)” was higher for 10–14 and 15+ drinkers (9th) than for 5–9 drinkers (11th).

Contexts—Overall, the most commonly endorsed context was at a party (endorsed by 82% of the sample), followed by during the day (31%), in a car (25%), and when alone (22%). Drinking at school was endorsed by the fewest respondents overall (7%). In contrast to the differences in rank order of reasons by drinking category, the rank order of drinking contexts was generally similar across drinking categories, with the exception that drinking alone was ranked slightly higher than drinking in a car for <5 drinkers.

RA 2: Bivariate comparison of individual and total reason/context endorsement prevalence by drinking category

Overall chi-square tests of differences in the percentages of students endorsing each individual reason and context by drinking category were conducted; all were significant at $p < .001$ with the exception of the reason “to fit in” (no overall significance indicated). The results of pairwise chi-square significance tests are indicated in the far-right column of Table 2, as are results from bivariate t-tests for drinking category differences in total number of reasons and contexts endorsed.

Reasons—All pairwise comparisons were significant ($p < .01$) for the reason “to increase the effects of other drugs”; endorsement prevalence significantly increased with the number of drinks reported. Pairwise comparisons other than 5–9 drinks versus 10–14 drinks were

significant for 10 reasons: to have a good time; to relax; because it tastes good; to get away from problems; e; to sleep; to seek deeper insights; to get through the day; because I'm hooked; to decrease effects of other drugs. Prevalence patterns for these reasons was generally lowest for <5 drinks and highest for 15+ drinks, with the exception of to have a good time, which was most prevalent for the 5–9 and 10–14 categories (compared with the <5 and 15+ categories). Finally, pairwise comparisons other than 10–14 drinks versus 15+ drinks were significant for three reasons: to experiment; to get high; and because of boredom. For experimentation, endorsement prevalence was highest for <5 drinks, significantly lower for 5–9, and lowest for 10–14/15+ drinks. For both get high and boredom, endorsement prevalence was lowest for <5 drinks and highest for 10–14/15+ drinks. When comparing the total number of reasons endorsed across drinking category, all pairwise comparisons were significant; the mean number of reasons increased significantly with the number of drinks reported.

Contexts—For all but one context (at a party), all pairwise comparisons were significant ($p < .01$), with the prevalence of endorsement increasing with number of drinks reported. For the party context, all pairwise comparisons were significant other than 10–14 drinks and 15+ drinks, which recorded the highest endorsement. When comparing the total number of contexts endorsed across drinking category, all pairwise comparisons were significant. As with total reasons, the mean number of contexts increased significantly with the number of drinks reported.

RA 3: Multivariable associations between reasons and contexts and drinking category

Multivariable multinomial logistic regression estimates of the relative risk of membership in each drinking category based on individual reason and context endorsement are presented in Table 3, simultaneously controlling for all other reasons, contexts and covariates (covariate associations are presented in Table 4). The first three columns of estimates were obtained from the model where 5–9 drinks was the base class. The final column of estimates was obtained from the model using 10–14 drinks as the base class.

Specific reasons—In the multivariable context, the relative risk of <5 drinks (vs. 5–9 drinks) was significantly higher for those endorsing to experiment, and was significantly lower for those endorsing to have a good time, to relax, because it tastes good, and to get high. The relative risk of 10–14 drinks (vs. 5–9 drinks) was significantly lower for those endorsing to experiment, and significantly higher for those endorsing because of anger/frustration. The relative risk of 15+ drinks (vs. 5–9 drinks) was significantly lower for those endorsing to have a good time, to experiment, and to get high. In contrast, the relative risk of 15+ drinks (vs. 5–9 drinks) was significantly higher for those endorsing because it tastes good, because of anger/frustration, to both increase and decrease the effects of other drugs, and because of being hooked. In terms of differentiating between HID levels, the relative risk of lower HID (10–14 drinks vs. 15+ drinks) was significantly higher for those endorsing to have a good time and to feel good, and significantly lower for those endorsing because it tastes good and because of being hooked.

Thus, in regards to reason groupings that differentiated between 5–9 drinking and any level of HID (10–14 or 15+ drinks), a lower risk of HID was associated with three of the five social/reactional reasons, while a higher risk of HID was associated with (a) one of the three coping with negative affect reasons, (b) one of the two compulsive use reasons, (c) both drug effect reasons, and (d) one miscellaneous reason (taste). In regards to reasons that differentiated between HID levels (10–14 vs. 15+ drinks), a lower risk of 15+ drinks was associated with two of the five social/recreational reasons, while a higher risk of 15+ drinks was associated with one of the two compulsive use reasons and one miscellaneous reasons (taste).

Specific contexts—In the multivariable context, the relative risk of <5 drinks (vs. 5–9 drinks) was significantly lower for those reporting use at a party, during the daytime, and in a car, but significantly higher for those reporting use at school. The relative risk of 10–14 drinks (vs. 5–9 drinks) was significantly higher for individuals reporting use in all contexts other than at school. Finally, the relative risk of 15+ drinks (vs. 5–9 drinks) was significantly higher for individuals reporting use in all five of the listed contexts. The relative risk of 10–14 drinks (vs. 15+ drinks) was significantly lower for individuals reporting use during the daytime and at school.

Covariate associations—After controlling for drinking reasons and contexts, several key covariate associations remained significant predictors of the relative risk of membership in drinking category (see Table 4). The relative risk of <5 drinks (vs. 5–9 drinks) was significantly lower for males and respondents with higher truancy, number of evenings out, and number of friends who got drunk, but significantly higher for Black and “other” racial/ethnic students (vs. Whites), and rural (vs. urban) students. The relative risk of 10–14 drinks (vs. 5–9 drinks) was significantly higher for males and those with a higher number of friends who got drunk. The relative risk of 15+ drinks (vs. 5–9 drinks) was significantly lower for individuals whose parents had some college education, and for students in the Northeast and West (vs. South), but significantly higher for males, students with higher truancy and number of friends who got drunk, as well as rural (vs. urban) students. In regards to differentiating between HID levels, the relative risk of lower HID (10–14 drinks vs. 15+ drinks) was significantly lower for males, “other” racial/ethnic students (vs. White students), and respondents with higher truancy and number of friends who got drunk, and significantly higher for students in the Northeast and West (vs. South).

Total reasons and contexts—Multivariable multinomial logistic regression estimates of the relative risk of membership in each drinking category based on the total number of reasons and contexts endorsed are presented in Table 5, simultaneously controlling for all covariates (covariate associations not shown). The relative risk of <5 drinks (vs. 5–9 drinks) decreased as the number of total reasons and contexts increased. No difference in the relative risk of 10–14 drinks versus 5–9 drinks was observed based on the total number of reasons endorsed, but the risk for 10–14 drinks increased as the total number of contexts increased. The relative risk of 15+ drinks (vs. 5–9 drinks) increased significantly as the total number of reasons or contexts increased. The relative risk of 15+ drinks (vs. 10–14 drinks) also increased significantly as the total number of reasons or contexts increased. Thus, the total

number of both reasons and contexts differentiated 5–9 drinking and any level of HID (either 10–14 or 15+), as well as differentiated between HID levels.

Discussion

More than one-fourth of U.S. 12th grade students who reported past 12-month alcohol use between 2005 and 2016 drank at or above the binge threshold. Of those reporting such behavior, approximately half reported HID. While drinkers in all categories (<5, 5–9, 10–14, and 15+ drinks) endorsed “to have a good time” as the most prevalent reason for alcohol use and “at a party” as the most prevalent context of alcohol use, specific patterns of reason endorsement differentiated HID from lower drinking levels, as well as differentiated between levels of HID involvement. Results indicated that adolescents who reported HID were particularly likely to drink for coping, compulsive use, and drug effect reasons, as well as because they enjoyed the taste. High levels of HID (vs. lower HID) were particularly associated with compulsive use and enjoying the taste. The relative risk of any HID, and of higher levels of HID involvement, increased with the total number of reasons and contexts endorsed. Alcohol appears to serve a larger number of functions for HID adolescents than non-HID youth.

Given that those who engage in HID are more likely than those who do not engage in HID to experience significant negative consequences due to drinking behavior (Hingson & White, 2013; Jackson, 2008; Read et al., 2008), it is important to understand the various functions that such drinking serves among adolescents. As other researchers have noted, interventions that ignore the perceived and subjective rewards of high-risk drinking behaviors such as HID may be unsuccessful (Coffman et al., 2007). The findings of the current study indicate that, holding endorsement of all other reasons and contexts constant, endorsement of reasons associated with coping with negative affect (because of anger/frustration) and compulsive use (because I’m hooked) significantly increased the relative risk of engaging in HID versus 5–9 drinking (drinking at binge levels). These findings are supported by prior research among both adolescents and adults, which have found that coping-related motives and reasons are strongly associated with both alcohol consumption levels and/or drinking problems (Carey & Correia 1997; Cooper, 1994; Cooper et al., 1995; Kuntsche et al., 2005; Patrick et al., 2011a). The current study adds to a growing literature indicating that the recognized connection between coping-related reasons and increased alcohol use extends beyond differentiating between non-binge and binge drinking into differentiating between binge drinking and HID involvement (Patrick et al., in press; White et al., 2016). HID may, for some individuals, involve self-medication for a range of issues including depression and anxiety; the degree to which HID is comorbid with depression/anxiety and other personality characteristics/disorders is a subject for future research.

Prior research with adolescents found that individuals who endorsed drug effect reasons at age 18 were significantly more likely to report symptoms of alcohol use disorder 17 years later (at age 35) (Patrick et al., 2011a), even after controlling for age 18 alcohol use in the form of any 5+ drinking. The current study indicated that the risk for HID (vs. 5–9 drinking) was significantly higher for individuals endorsing drug effect reasons (to increase or decrease the effects of other drugs). The finding that drug effect reasons at age 18 are

associated with higher risk of HID at age 18 may help explain the predictive connection between such reasons and later symptoms of alcohol use disorder.

Endorsing the reason of “because it tastes good” was associated with higher risk of any HID (vs. 5–9 drinks), as well as higher HID involvement (15+ drinks vs. 10–14 drinks). Ethanol is reported to elicit both sweet and bitter sensations (Mattes & DiMeglio, 2001), and individual differences in perceptions of bitterness and sweetness when consuming alcohol are predictors of alcohol intake (Lanier, Hayes, & Duffy, 2005). Several studies have linked genetic variation in bitter receptor genes to alcohol intake, finding that individuals who perceive less bitterness in alcohol consume more (Duffy et al., 2004a; Duffy, Peterson, & Bartoshuk, 2004b; Hayes et al., 2011). Additional research has identified genetic variation in the degree to which individuals perceive alcohol to cause burning or stinging sensations (Allen, McGeary, & Hayes, 2014). The finding in the current study that HID (and higher levels of HID) were associated with liking the taste of alcohol may, in part, reflect individual genetic differences in the sensations elicited by alcohol consumption.

The current study indicated that endorsement of several social/recreational reasons (to have a good time; to experiment; to get high) was associated with lower relative risk of HID (vs. 5–9 drinks), and lower relative risk of 15+ drinks (vs. 10–14 drinks) was associated with endorsement of two social/recreational reasons (to have a good time; to get high). These findings do not indicate that HID is a non-social phenomenon. The most frequently endorsed reason among each drinking category (including both HID categories) was “to have a good time with my friends”, and the most frequently endorsed context was “at a party”. Given that the analytic models estimated the association between a specific reason or context and drinking category while holding endorsement of all other reasons and contexts constant, the results indicate that, all else being equal, endorsement of social/recreational reasons was less likely to be a unique indicator of HID because they were so commonly endorsed across levels of drinking.

A key finding of the current study was as the total number of reasons and contexts endorsed increased, so too did the relative risk of membership in HID, as well as higher levels of HID. Prior research has indicated that alcohol consumption and other risk-related outcomes such as early initiation of alcohol use are higher among “multiple-reason” drinkers (Coffman et al., 2007; Johnston & O’Malley, 1986; Montgomery, Benedicto, & Haemmerlie, 1993; Plant et al., 1990) as well as “multiple-context” drinkers (Stewart & Power, 2002). To the extent that an adolescent uses alcohol for a broad range of reasons in a wide range of contexts, it is natural that their consumption would increase. Put another way, the current study indicates that adolescent HID may be associated with using alcohol to fulfill a range of functions and situations that other adolescents navigate without drinking. Helping adolescents be able to navigate social situations, stresses, and personal difficulties without using alcohol may be especially important for treatment/intervention efforts with HID youth.

Limitations

These findings should be considered within their limitations. Data were cross-sectional (precluding causal interpretation) and based on self-reports. Self-report substance use data have been found to be reasonably reliable and valid under appropriate conditions, which the

MTF study has striven to provide (Brener, Billy, & Grady, 2003; Miech et al., 2016; O'Malley, Bachman, & Johnston, 1983). However, respondents may have difficulty reporting the number of drinks consumed at HID levels and examination of measurement error for the HID measures is needed (Patrick, 2016). Findings may not generalize to settings outside of the U.S. (e.g., Gire, 2002) or to individuals who drop out of high school. Lower educational attainment is associated with higher alcohol use (Substance Abuse and Mental Health Services Association, 2013), indicating our estimates of HID may be somewhat lower than would otherwise be found. Although the current NIAAA definition of binge drinking is 5+ drinks for men, but 4+ drinks for women to compensate for body size and alcohol metabolism differences (NIAAA, n.d.), the drinking category measure used in the current study (< 5 drinks, 5–9 drinks, 10–14 drinks, and 15+ drinks) was the same for both boys and girls. Although the lack of gender-specific HID measures does potentially affect estimates of overall population HID prevalence, it is not unreasonable to believe that the observed associations between endorsed reasons and contexts for alcohol use and drinking category are valid for both boys and girls. Further, additional constructs that may be associated with drinking motives/contexts and alcohol use, such as comorbid mental health disorders or personality characteristics, are not included in the current analysis. Limitations notwithstanding, the current study contributes significantly to adolescent alcohol use epidemiology by using large, nationally representative samples of 12th grade students from 2005–2016 to examine associations between self-reported reasons and contexts of alcohol use and HID.

Conclusions

Among US 12th grade students who reported past 12-month alcohol use, HID was particularly likely among adolescents who reported drinking for coping, compulsive use, and drug effect reasons, as well as those who enjoyed the taste. As the total number of reasons and contexts endorsed increased, the relative risk of HID (including higher levels of HID) also increased.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1Descriptive Statistics: U.S. 12th Grade Alcohol Users, 2005–2016

	%/Mean	SE	Range	% Missing
<u>Outcome: Drinking Category^a</u>				0.0
< 5 drinks	72.4	0.57	(0, 1)	
5–9 drinks	13.8	0.35	(0, 1)	
10–14 drinks	6.8	0.27	(0, 1)	
15+ drinks	7.0	0.27	(0, 1)	
<u>Covariates</u>				
Gender				7.0
Female	52.4	0.58	(0, 1)	
Male	47.6	0.58	(0, 1)	
Race/ethnicity				6.8
White	64.8	1.08	(0, 1)	
Black	9.5	0.57	(0, 1)	
Hispanic	14.2	0.86	(0, 1)	
Other race	11.5	0.43	(0, 1)	
Parent education				9.2
Some college education	73.1	0.67	(0, 1)	
No college education	26.9	0.67	(0, 1)	
Grades				9.7
Average high school grades	6.4	0.02	(1–9)	
Truancy				11.4
Number of days cut school	1.9	0.02	(1–7)	
Evenings out				11.6
Number of evenings out	3.4	0.02	(1–6)	
Friends drunk				6.0
Number of friends drunk	2.6	0.02	(1–5)	
Urbanicity				0.0
Urban	30.9	1.66	(0, 1)	
Rural	21.3	0.80	(0, 1)	
Suburban	47.8	1.67	(0, 1)	
Region				0.0
Midwest	23.8	0.89	(0, 1)	
Northeast	20.0	0.91	(0, 1)	
South	34.9	1.08	(0, 1)	
West	21.3	0.97	(0, 1)	

Notes: N (unweighted) = 16,902.

^aDrinking category refers to maximum number of drinks per occasion reported in the past two weeks.

Table 2 Endorsement Prevalence of Alcohol Use Reasons and Contexts among U.S. 12th Grade Alcohol Users, Overall and by Drinking Category: 2005–2016

	Overall	Drinking Category ^a					Pairwise Comparison Results ^b
		< 5 %/Mean	5–9 %/Mean	10–14 %/Mean	15+ %/Mean		
Reasons							
To have a good time with my friends	73.0	66.9	89.3	91.7	85.1	b	
To experiment – to see what it’s like	52.3	58.1	41.7	34.1	31.2	c	
To relax or relieve tension	42.3	36.5	54.2	57.2	64.9	b	
Because it tastes good	36.4	32.9	40.4	45.1	57.3	b	
To feel good or get high	34.1	25.9	52.4	59.0	59.0	c	
To get away from my problems or troubles	21.4	17.7	27.5	29.8	39.3	b	
Because of boredom, nothing else to do	20.7	17.0	27.0	33.1	34.4	c	
Because of anger or frustration	12.7	9.7	15.8	21.1	29.6	b	
To get to sleep	6.6	5.3	7.8	7.9	16.9	b	
To fit in with a group I like	6.2	6.1	6.4	5.2	7.7	d	
To seek deeper insights and understanding	6.1	4.6	7.5	9.0	15.9	b	
To increase the effects of some other drug(s)	5.1	2.8	6.7	11.6	20.0	a	
To get through the day	3.2	2.0	4.0	4.8	12.9	b	
Because I am “hooked” – I feel I have to drink	1.5	0.6	1.3	2.7	10.0	b	
To decrease (offset) the effect of some other drug(s)	0.9	0.3	1.1	1.7	5.9	b	
Total number of reasons (range = 1–15)	3.2	2.9	3.8	4.1	4.9	a	
Contexts							
At a party	82.3	76.7	95.6	98.1	98.4	c	
During the daytime (before 4:00 p.m.)	30.5	22.1	41.0	55.1	72.5	a	
In a car	25.3	16.9	37.0	51.5	64.4	a	
When you were alone	22.4	18.5	23.3	33.2	50.7	a	
At school	7.2	4.6	7.1	11.9	29.5	a	
Total number of contexts (range = 0–5)	1.7	1.4	2.0	2.5	3.2	a	
(Unweighted n)	(16,902)	(12,163)	(2,422)	(1,155)	(1,162)		

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Notes: Due to the number of pairwise comparisons, identification of significance is limited to associations with $p < .01$. For pairwise comparisons: a = all pairwise comparisons significantly different at $p < 0.01$; b = all pairwise comparisons except 5–9 drinkers versus 10–14 drinkers significantly different at $p < 0.01$; c = all pairwise comparisons except 10–14 drinkers versus 15+ drinkers significantly different at $p < 0.01$; d = no significant pairwise comparisons.

^aDrinking category refers to maximum number of drinks per occasion reported in the past two weeks.

Table 3
Multivariable Multinomial Logistic Regression Associations between Alcohol Use Reason/Context Endorsement and Drinking Category among U.S. 12th Grade Alcohol Users, 2005–2016

	Model 1 ^a		Model 2 ^b	
	<5 Drinks [vs. 5–9] ARR (95% CI) p	10–14 Drinks [vs. 5–9] ARR (95% CI) p	15+ Drinks [vs. 5–9] ARR (95% CI) p	10–14 Drinks [vs. 15+] ARR (95% CI) p
<u>Social/recreational reasons</u>				
To have a good time with friends	0.51 (0.43, 0.60) ***	1.14 (0.83, 1.56)	0.58 (0.43, 0.78) ***	1.97 (1.41, 2.74) ***
To experiment	1.69 (1.51, 1.89) ***	0.76 (0.64, 0.90) **	0.63 (0.52, 0.75) ***	1.21 (0.99, 1.49)
To feel good/get high	0.59 (0.52, 0.67) ***	1.03 (0.85, 1.25)	0.77 (0.63, 0.94) *	1.34 (1.07, 1.69) *
Because of boredom/nothing else to do	0.94 (0.82, 1.08)	1.07 (0.88, 1.31)	0.88 (0.71, 1.09)	1.22 (0.97, 1.53)
To fit in with a group I like	1.23 (0.98, 1.53)	0.76 (0.51, 1.13)	0.92 (0.62, 1.36)	0.83 (0.53, 1.28)
<u>Coping with negative affect reasons</u>				
To relax or relieve tension	0.79 (0.69, 0.89) ***	0.89 (0.73, 1.07)	0.94 (0.77, 1.16)	0.94 (0.74, 1.19)
To get away from problems/troubles	0.99 (0.85, 1.15)	0.90 (0.72, 1.12)	1.03 (0.82, 1.29)	0.87 (0.68, 1.12)
Because of anger/frustration	0.92 (0.76, 1.11)	1.40 (1.08, 1.82) *	1.47 (1.12, 1.93) **	0.95 (0.71, 1.28)
<u>Compulsive use reasons</u>				
To get through the day	0.87 (0.61, 1.25)	0.88 (0.57, 1.36)	1.05 (0.70, 1.58)	0.84 (0.55, 1.28)
Because I am “hooked”	0.79 (0.46, 1.35)	1.58 (0.91, 2.75)	2.84 (1.75, 4.61) ***	0.56 (0.35, 0.90) *
<u>Drug effect reasons</u>				
To increase effects of other drug(s)	1.13 (0.89, 1.43)	1.30 (0.97, 1.75)	1.49 (1.10, 2.00) **	0.88 (0.64, 1.20)
To decrease effects of other drug(s)	0.57 (0.31, 1.05)	1.27 (0.61, 2.61)	2.15 (1.07, 4.30) *	0.59 (0.30, 1.16)
<u>Miscellaneous reasons</u>				
Because it tastes good	0.87 (0.77, 0.97) *	1.09 (0.90, 1.32)	1.54 (1.29, 1.85) ***	0.71 (0.57, 0.87) **
To get to sleep	0.92 (0.72, 1.19)	0.76 (0.56, 1.03)	1.04 (0.76, 1.43)	0.73 (0.52, 1.03)
To seek deeper insights/understanding	0.94 (0.74, 1.19)	0.95 (0.69, 1.31)	1.12 (0.83, 1.52)	0.85 (0.60, 1.19)
<u>Contexts</u>				
At a party	0.32 (0.25, 0.40) ***	1.77 (1.08, 2.88) *	2.22 (1.22, 4.02) **	0.80 (0.40, 1.57)

	Model 1 ^a		Model 2 ^b	
	<5 Drinks [vs. 5-9] ARR (95% CI) p	10-14 Drinks [vs. 5-9] ARR (95% CI) p	15+ Drinks [vs. 5-9] ARR (95% CI) p	10-14 Drinks [vs. 15+] ARR (95% CI) p
During the daytime (before 4:00 p.m.)	0.59 (0.53, 0.67) ***	1.31 (1.09, 1.59) **	1.97 (1.61, 2.40) ***	0.67 (0.54, 0.83) ***
In a car	0.63 (0.55, 0.71) ***	1.40 (1.17, 1.69) ***	1.63 (1.33, 1.98) ***	0.86 (0.69, 1.08)
When you were alone	1.05 (0.90, 1.22)	1.29 (1.05, 1.59) *	1.53 (1.23, 1.89) ***	0.85 (0.67, 1.07)
At school	1.32 (1.04, 1.69) *	1.16 (0.85, 1.57)	2.14 (1.62, 2.82) ***	0.54 (0.40, 0.72) ***

Notes: N (unweighted) = 16,902. ARR = adjusted relative risk ratio; CI = confidence interval. Models controlled for all reasons and contexts simultaneously, as well as covariates (covariate estimates provided in Table 4).

* p<0.05;

** p<0.01;

*** p<0.001.

^aModel 1 results use 5-9 drinks as the base class.

^bModel 2 results use 15+ drinks as the base class to enable comparison of the likelihoods of 10-14 versus 15+ drinks by reason/context endorsement.

Table 4
 Multivariable Multinomial Logistic Regression Associations between Covariates and Drinking Category among U.S. 12th Grade Alcohol Users, 2005–2016

	Model 1a		Model 2b	
	<5 Drinks [vs. 5–9] ARR (95% CI) p	10–14 Drinks [vs. 5–9] ARR (95% CI) p	15+ Drinks [vs. 5–9] ARR (95% CI) p	10–14 Drinks [vs. 15+] ARR (95% CI) p
Gender (referent = female)	0.71 (0.63, 0.80) ***	2.14 (1.76, 2.60) ***	3.62 (2.96, 4.42) ***	0.59 (0.46, 0.76) ***
Race (referent = White)				
Black	1.75 (1.36, 2.25) ***	0.81 (0.49, 1.33)	0.65 (0.40, 1.05)	1.25 (0.71, 2.21)
Hispanic	1.15 (0.96, 1.39)	0.74 (0.54, 1.00)	0.98 (0.70, 1.35)	0.76 (0.52, 1.10)
Other race	1.46 (1.21, 1.76) ***	0.72 (0.51, 1.02)	1.07 (0.77, 1.49)	0.68 (0.46, 0.99) *
Parent education (referent = no college)	0.90 (0.77, 1.04)	0.90 (0.72, 1.12)	0.71 (0.56, 0.88) **	1.27 (0.99, 1.64)
Average high school grades	0.99 (0.96, 1.02)	0.98 (0.94, 1.03)	1.02 (0.96, 1.08)	0.96 (0.91, 1.02)
Days cut school	0.96 (0.92, 1.00) *	0.99 (0.94, 1.06)	1.11 (1.05, 1.17) ***	0.90 (0.84, 0.96) **
Evenings out	0.89 (0.85, 0.92) ***	1.05 (0.97, 1.13)	1.05 (0.98, 1.13)	1.00 (0.91, 1.09)
Friends drunk	0.72 (0.69, 0.76) ***	1.23 (1.12, 1.35) ***	1.39 (1.26, 1.54) ***	0.88 (0.79, 0.99) *
Urbanicity (referent = Urban)				
Rural	1.21 (1.02, 1.43) *	1.26 (0.99, 1.61)	1.41 (1.09, 1.83) **	0.89 (0.66, 1.20)
Suburban	0.99 (0.87, 1.13)	0.99 (0.81, 1.21)	1.00 (0.82, 1.23)	0.99 (0.78, 1.25)
Region (referent = South)				
Midwest	0.99 (0.84, 1.16)	1.10 (0.87, 1.39)	1.23 (0.96, 1.56)	0.89 (0.68, 1.17)
Northeast	0.96 (0.82, 1.12)	1.14 (0.91, 1.42)	0.80 (0.64, 1.00) *	1.43 (1.09, 1.87) *
West	0.94 (0.80, 1.10)	0.97 (0.73, 1.29)	0.66 (0.50, 0.87) **	1.48 (1.07, 2.05) *
Year (linear term) ^b	1.02 (1.00, 1.03)	1.00 (0.97, 1.02)	1.01 (0.98, 1.04)	0.98 (0.95, 1.02)
Year (quadratic term) ^c	1.00 (1.00, 1.01)	0.99 (0.98, 1.00) *	0.99 (0.98, 1.00)	1.00 (0.99, 1.01)

Notes: N (unweighted) = 16,902. ARR = adjusted relative risk ratio; CI = confidence interval. Models simultaneously controlled for all reasons and contexts (estimates provided in Table 3), as well as listed covariates and missing data indicators (estimates for missing data indicators not shown).

* p<0.05.

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p<0.01,

p<0.001.

^aModel 1 results use 5–9 drinks as the base class.

^bModel 2 results use 15+ drinks as the base class to enable comparison of the likelihoods of 10–14 versus 15+ drinks by reason/context endorsement.

Table 5
 Multivariable Multinomial Logistic Regression Associations between Total Number of Alcohol Use Reason/Context Endorsements and Drinking Category among U.S. 12th Grade Alcohol Users, 2005–2016

	Model 1 ^a		Model 2 ^b	
	<5 Drinks [vs. 5-9] ARR (95% CI) p	10-14 Drinks [vs. 5-9] ARR (95% CI) p	15+ Drinks [vs. 5-9] ARR (95% CI) p	10-14 Drinks [vs. 15+] ARR (95% CI) p
Total number of reasons	0.89 (0.87, 0.91) ***	0.99 (0.96, 1.03)	1.04 (1.00, 1.08) *	0.95 (0.91, 0.99) *
Total number of contexts	0.67 (0.63, 0.69) ***	1.31 (1.21, 1.41) ***	1.81 (1.67, 1.97) ***	0.72 (0.66, 0.78) ***

Notes: N (unweighted) = 16,902. ARR = adjusted relative risk ratio; CI = confidence interval. Models controlled for total reasons and contexts simultaneously, as well as covariates listed in Table 1 (estimates for covariates not shown).

* p<0.05;

** p<0.01;

*** p<0.001.

^aModel 1 results use 5–9 drinks as the base class.

^bModel 2 results use 15+ drinks as the base class to enable comparison of the likelihoods of 10–14 versus 15+ drinks by reason/context endorsement.