Title

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Authors

Schuckit, Marc A
Smith, Tom L
Goncalves, Priscila Dib
et al.

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Alcohol-Related Blackouts across 55 Weeks of College: Effects of European-American Ethnicity, Female Sex, and Low Level of Response to Alcohol

Marc A. Schuckit[1], **Tom L. Smith**[1], **Priscila Dib Goncalves**[1,2], and **Robert Anthenelli**[1]

Marc A. Schuckit: mschuckit@ucsd.edu; Tom L. Smith: tomsmith@ucsd.edu; Priscila Dib Goncalves: pri_dib@yahoo.com.br; Robert Anthenelli: ranthenelli@ucsd.edu

[1]University of California, San Diego School of Medicine, Department of Psychiatry, 9500 Gilman Drive, MC 0866, La Jolla, CA 92093-0866

[2]University of São Paulo, Institute of Psychiatry, Psychology and Neuropsychology Service, Rua Ovidio Pires de Campos, 785, São Paulo, SP, Brazil 05403-010

Abstract

Background—While high blood alcohol concentrations (BACs) are required for alcohol-related blackouts (ARBs), additional characteristics also contribute to the risk, including a person's ethnicity, sex, and phenotypes relating to heavier drinking. Few prospective studies of ARBs have evaluated how these additional characteristics interact.

Method—Data regarding 398 European American (EA), Asian and Hispanic students were extracted from a 55-week prospective study of different approaches to decrease heavy drinking among college freshmen. Information on past month ARB frequency was determined at 8 assessments. While controlling for the prior month maximum BAC and active education vs. control group assignment, the patterns and intensities of ARBs over time across ethnic groups were evaluated with ANOVA at each follow-up for the full sample, and then separately by sex and then by low vs. high levels of response to alcohol status (LR). The overall pattern of ARBs over time was evaluated with a 3 ethnic groups by 2 sexes by 2 LR status by 8 time points mixed-design ANOVA.

Results—Higher rates of ARBs over time were associated with EA ethnicity, female sex and a low LR to alcohol, with the ethnic differences in ARBs most robust in females and drinkers with high LRs. Participation in education programs aimed at heavy drinking was associated with decreases in ARBs.

Conclusions—The data indicate that in addition to BACs achieved, propensities toward ARBs relate to complex interactions between additional risk factors, including ethnicity, sex, and LR status.

Correspondence to: Marc A. Schuckit, `mschuckit@ucsd.edu`.

Keywords

alcohol; blackouts; alcohol response; college students; race; sex

1. INTRODUCTION

Lifetime risks for alcohol-related blackouts (ARBs) in many surveys is >50% among drinkers (Barnett et al., 2014; Schuckit et al., 2015; White et al., 2002). The high blood alcohol concentrations (BACs) involved (Goodwin, 1995; Perry et al., 2006) and the compromised cognitive processes inherent in ARBs (Silveri et al., 2014) increase risks for additional serious consequences, including accidents, unwanted sex, and exposure to other forms of violence (Hingson et al., 2016, Mundt and Zakletskaia, 2012; White et al., 2004). In addition to BACs>.20g/dl needed for most blackouts, ARBs are also associated with European American [EA] ancestry, female sex, and several genetically-influenced phenotypes related to heavier drinking, including a low level of response (low LR) to alcohol, as described further below (Marino and Fromme, 2015, 2016; Schuckit et al., 2015, 2001; Wetherill and Fromme, 2016, 2009; White et al., 2015). However, the relationships among these characteristics and ARBs are complex and their potential interactions have not been adequately evaluated (Wetherill and Fromme, 2016).

The link of ethnicity to ARBs may relate to heavier drinking in EAs and, potentially, Hispanics, compared to other populations such as Asian individuals (LaBrie et al., 2011; Marino and Fromme, 2015). Ethnic differences may also reflect divergent patterns of alcohol metabolizing enzymes, as Asians have higher rates of mutations in both aldehyde dehydrogenase (ALDH 2,2) and alcohol dehydrogenase (ADH1B) that produce greater alcohol sensitivities and contribute to lower levels of heavier drinking with subsequent lower rates of ARBs (Eng et al., 2007; Luczak et al., 2011). EAs, Asians, and Hispanics also differ on cultural-based proscriptions against heavy drinking, especially in women (e.g., Chartier and Caetano, 2009), have different rates of low LRs unrelated to alcohol metabolism (Ehlers et al., 2004; Luczak et al., 2002), and vary regarding typical body mass indices, with the latter likely to affect BACs per drink (Centers for Disease Control, 2015).

One contributor to higher ARB rates in women (Marino and Fromme, 2015; Schuckit et al., 2015) may be their higher BACs per drink (Baraona et al., 2001; Rose and Grant, 2010). This reflects women's likely lower body weight, less first pass metabolism of alcohol, and higher body fat with corresponding less body water per pound. However, there is overlap between ethnic background and drinking patterns among women, and it is not clear if those two characteristics interact regarding ARBs.

Both ethnicity and sex also relate to low LRs to alcohol (Eng et al., 2005; Luczak et al., 2006; Marino and Fromme, 2016; Schuckit et al., in press; Wetherill and Fromme, 2009). However, LR differences across EA, Hispanic, and Asian individuals (e.g., Ehlers et al., 2004; Luczak et al., 2002), and across sexes (Schuckit et al., 2012b) raise questions about how LR interacts with ethnicity and sex to contribute to ARBs.

A recent review highlighted the paucity of prospective studies evaluating how multiple risk factors interact in contributing to ARBs, while controlling for alcohol quantities (Wetherill and Fromme, 2016). In response, the present analyses extracted information from a 55-week prospective study that evaluated educational approaches to preventing heavy drinking on campus (Schuckit et al., 2016a). The data tested four hypotheses: Hypothesis 1 states that relationships of ethnicity to ARBs will remain even after controlling for the maximum number of drinks consumed, with the highest ARB prevalence in EA and Hispanic and the lowest rates in Asian students. Hypothesis 2 is that ARB rates will be higher in females, and that the ethnic differences will remain robust after considering sex and controlling for maximum drinks. Hypothesis 3 proposes that low LRs will relate to ARBs, and that ethnic differences will remain even after considering maximum drinks and LR. Hypothesis 4 states that ethnic group status will interact with sex and LR to predict rates of ARBs over 55 weeks.

2. MATERIAL AND METHODS

2.1 Original Subject selection and education group assignment

Following University of California, San Diego (UCSD) Human Protections Committee approval, in January, 2014, 18-year-old freshmen were selected from respondents to questionnaires emailed to UCSD students to solicit participants for a 55-week study of ways to diminish heavy drinking in college students (Schuckit et al., 2016a, 2016b). No student was selected because of current or past alcohol problems, and based on questions extracted from the Semi-Structured Assessment for the Genetics of Alcoholism interview (SSAGA; Bucholz et al., 1994; Hesselbrock et al., 1999), the protocol excluded nondrinkers, individuals with severe psychiatric diagnoses (e.g., bipolar disorder), students who ever met DSM-IV criteria for dependence on alcohol or illicit drugs (American Psychiatric Association, 2000), and Asian individuals who became physically ill after one standard drink (10–12 gm of ethanol). Five-hundred subjects were enrolled, half above and half below the median for the number of drinks required for effects the first five times of drinking using the Self Report of the Effects of Alcohol (SRE) questionnaire. The SRE determines the mean number of standard drinks needed across up to four possible alcohol effects actually experienced early in the drinking career. These included the drinks required to produce any effect, slurred speech, unsteady gait, and unwanted falling asleep. The SRE has Cronbach alphas and repeat reliabilities >.88 (Ray et al., 2011; Schuckit et al., 2015, 1997). This retrospective self-report measure was used rather than alcohol challenges because the latter are too expensive and time consuming for use in a large population (Schuckit and Gold, 1988). The overlap between SRE and alcohol challenge-based LRs in predicting heavy drinking and alcohol problems is 60%, and the measures produce similar results when used in different generations of the same families (Schuckit et al., 2012a, 2009). High and low LR subjects were randomly assigned to three conditions: those who watched 5 videos regarding two different prevention approaches and no-intervention controls. The latter helped control for general-campus-related changes in drinking over time, and, reflecting the emphasis in the larger study on the impact of education groups, most students were assigned to active education.

2.2 Assessments

Using Survey Monkey, subjects reported drinking patterns and ARB experiences for the prior month at baseline (Time 1or T1), 1 month, 2 months, and each subsequent 1–3 months over 55 weeks. (Schuckit et al., 2016a). At baseline, demographic and substance-related questions were extracted from the SSAGA interview (Bucholz et al., 1994; Hesselbrock et al., 1999). Of central interest to current analyses, alcohol related blackouts were evaluated by asking: "*Have you had blackouts where you could not remember later what you have done while drinking alcohol*? *How many times last month?".*

Baseline questions were repeated regarding drinking practices and numbers of prior month ARBs in: February, 2014 (T2), March (T3), May (T4), June (T5), August (T6, summer vacation), November (T7, returning to school) and February, 2015 (T8). T4 evaluations occurred 18 days after a campus-wide day-long celebration known for heavy drinking (Schuckit et al., 2016b)

Of 500 students enrolled, 462 (92.4%) of those in active education groups watched all videos, and to be included in analyses members of intervention and control groups had to complete >7 of 8 assessments. This high rate of cooperation was achieved by informing subjects of the importance of follow-ups at recruitment; through reminders via email, texts, and voice messages; and through prompt payment of $25 for each completed task. Considering our interest in relationships between ethnic group membership and ARB risk (Schuckit et al., 2016a), current analyses focus on the 398 individuals in the three largest self-identified ethnic groups at UCSD: 159 EA, 76 white Hispanic and 163 Asian (Japanese, Chinese, Korean) students. Sixty-four high and low LR individuals were not well matched on ethnicity because of a small pool of students of that ethnic background and were excluded from the analyses, including 25 students of Malaysian and/or Filipino heritage, 14 with Indian or Pakistani backgrounds, 11 with Middle Eastern or Persian heritage, 9 African Americans, 3 Native Americans, and 2 Pacific Islanders.

2.3 Statistical Analyses

The dependent variable was the number of ARBs the prior month at each assessment. Analyses began with data transformations based on distributional properties for numbers of ARBs and maximum drinks per occasion using inverse reflected and square root transformations, respectively. For the *first set of analyses,* to address Hypotheses 1–3, numbers of ARBs per assessment were compared across ethnic groups overall, ethnic groups among females and males separately, and ethnic groups among subjects with high and low LRs separately. As shown in Table 3 regarding each figure, at each assessment ethnic group differences were evaluated using two one-way ANOVAs, first presenting the F-value for differences in prior month ARBs across ethnic groups without controlling covariates, and again as F (residual) values controlling for maximum drinks consumed the prior month and for education group assignment (education vs. control). *The final analysis* in Table 4 addressed Hypothesis 4 by evaluating main and interaction effects for numbers of ARBs across eight time points using a 3 ethnic groups (EA, Hispanic, Asian) by 2 sexes by 2 LR categories (high and low) by 8 time points mixed-design ANOVA (time was the repeated measure) that controlled for maximum drinks while using education group as a covariate.

For all analyses, missing data were handled through a maximum likelihood procedure (Collins et al., 2001).

3. RESULTS

At baseline, the 398 eligible participants were 18-year-old UCSD freshmen, of whom 62% were female with 40% EA, 20% Hispanic, and 41% of Asian descent (Table 1). Table 2 presents the numbers of subjects across combinations of ethnicities, sex, and LR groups. The SRE values averaged 4 drinks across four possible effects actually experienced the first five times they drank. In the prior month, these students consumed on average 6 maximum and 4 usual drinks per occasion, with 4 drinking occasions per month. At baseline, 21% noted having experienced an ARB in the prior month, with an average of 0.33 such episodes (range 0 to 8). About 40% had used cannabis the prior month, and 87% were in the active intervention group in the prevention study.

Table 3 presents statistical analyses associated with the 3 figures, while Table 4 shows results of a mixed-design ANOVA (time was the repeated measure) for the overall statistical analysis regarding Hypothesis 4. These statistical results are mentioned here because they relate to interpretations of Hypotheses.

Figure 1 presents the average number of ARBs the month before each assessment for members of the three ethnic groups, with highest rates for EA students, lowest for Asian individuals, and an intermediate rate for Hispanic students. While not shown in the figures, over the 55 weeks 43.0% had at least 1 ARB, including 13.3% with 1, 8.8% with 2, 2.5% each with 4, 5, or 6 ARBs, and 0 to 1.0% each with between 7 and a maximum of 36 ARBs. As demonstrated by the absence of a significant ethnicity by time interaction in Table 4, general patterns of ups and downs in numbers of ARBs over 55-weeks were similar for the three groups where ARB values tended to diminish between January and March (Times 1 to 3), increase in June (Time 5) in concert with a campus festival known for heavy drinking, decrease again over the summer when most students returned home (August, Time 6), and rose after returning to school (Times 7 and 8). However, regarding Figure 1, as shown in Table 3 the ANOVAs carried out at each time point revealed significant differences in the average number of ARBs across groups at every evaluation. After controlling for maximum drinks reported at each assessment and education group assignment, residual statistics for ethnic group differences in ARBs at each time point across EA, Hispanic, and Asian subjects remained significant at Times 2 and 4. The absence of a main effect for ethnicity in the mixed-design ANOVA in Table 4 indicates the possibility that other characteristics (e.g., sex and LR) may have impacted results.

Therefore, Figure 2 presents ARB trajectories for the three ethnic groups for female and male students separately. While not shown, during the 55 weeks, 48.0% of females and 34.7% of males ($x^2 = 6.76$, $p<.01$) reported at least one ARB, with an average of 0.30 (SD=.61) and 0.19 (0.47) ($t= -2.00$, $p=.05$) ARBs per assessment, respectively. Ethnic group differences in ARBs were prominent among females, with the highest ARB rates for EA women, the lowest for Asian individuals, and intermediate, but relatively low, rates for Hispanics. Looking at each assessment for females, statistical analyses in Table 3

demonstrate significant ethnic differences in the rates of ARBs for raw ARB numbers at every assessment, which remained significant at times 4, 5 and 8 after controlling for education group and maximum drinks. Differences across ethnic groups were less apparent for males, and the ethnicity by sex by time interaction was significant in Table 4. Also, for between subjects' analyses where time was collapsed and average scores across the eight time points were used, there was a significant sex main effect, and the ethnicity by sex interaction was a trend (p=.07).

Next, the potential relationship of LR to the ethnic patterns of ARBs over time was evaluated in Figure 3. Here, high and low LR subjects showed the same general pattern of ARBs across time demonstrated in Figure 1, including highest rates of ARBs per assessment for EA, lowest for Asian, and intermediate rates for Hispanic students. However, ethnic group differences in ARBs were more robust for high LR subjects, with Table 3 revealing significant differences in raw ARB numbers across the three ethnic groups at every assessment, which remained significant at Time 7 after controlling for maximum drinks and education group assignment, with a trend at Time 4 (p=.057). The only significant differences in raw ARB numbers for low LR subjects were noted at Time 2 and 4, each of which lost significance once residuals were used. In Table 4 the sex by LR by time interaction was significant and the LR group by time interaction for patterns of ARBs was a trend (p=.10). Thus, the relationship of LR to differences in ARB patterns across ethnic groups was modest, and was most robust when considered in the context of sex effects.

Regarding Hypothesis 4, as briefly alluded to above, the overall analysis in Table 4 indicates interactions regarding ARBs among ethnicity, sex, and LR in two 3-way interactions (ethnicity by sex by time and sex by LR by time). However, the 4-way interaction was not significant.

It is important to note that cross-sectional data in Figures 1 to 3 were analyzed after controlling for the education group in which students participated. Table 4 offers additional information about effects of educational group assignment, which was used as a covariate. Here, the education group by time interaction was a trend (p=.072), and the education group main effect was significant, with controls having higher ARB frequencies than the active education participants.

4. DISCUSSION

Alcohol-related blackouts are highly prevalent phenomena associated with potentially severe problems (Hingson et al., 2016; Wetherill and Fromme, 2016). Recently, the prevalence of ARBs has reached alarming rates, especially in females and individuals with early onset drinking (Marino and Fromme, 2015; Schuckit et al., 2015; White et al., 2015). The UCSD freshmen studied here are no exception to these trends as 43% of these students reported at least 1 ARB during the 55 weeks, including 48% in females and 35% in males. While the risk for these alcohol-related anterograde memory lapses increases with BACs (Goodwin, 1995; Perry et al., 2006), ARB vulnerabilities were also related to ethnic background, female sex, and levels of response to alcohol. The patterns and interactions among these characteristics are the focus of this paper.

The current analyses added potentially useful data to the study of ARBs. The sample is relatively large, and subjects were assessed prospectively eight times over 55 weeks during a life-period likely to involve heavy drinking (Schuckit et al., 2016a; Wetherill and Fromme, 2016). Several assessments were scheduled at periods when the rates of ARBs were likely to change, including following a heavy drinking campus festival, summer break, and after returning to school as sophomores (Schuckit et al., 2016a, 2016b). Data were evaluated while controlling for maximum drinks, thus diminishing the possibility that ARB patterns simply reflected impacts of heavy drinking itself, and after controlling for possible effects of the prevention trial from which the data were extracted. The major questions focused on improving understanding of how ethnicity, sex, and LR related to rates of ARBs.

To address Hypothesis 1, evaluations began with documentation of expected ethnic group differences in rates of ARBs across time. Consistent with most prior studies, (e.g., LaBrie et al., 2011; Marino and Fromme, 2015) the highest rates were observed for students of EA origin, the lowest among Asian students, with an intermediate rate for Hispanic individuals. This pattern of the number of ARBs persisted after controlling for maximum drinks and the prevention group in which a person participated in the larger study. While fluctuations in ARBs across the year were fairly similar for the three ethnic groups (e.g., increasing during a festival, decreasing over summer, and rising upon return to school as sophomores), rates of ARBs were different across ethnicities.

As suggested by several recent papers (Wetherill and Fromme, 2016; White et al., 2015) and predicted in the first part of Hypothesis 2, women had higher ARB rates. However, contrary to the second half of that hypothesis, the relationship of ethnicities to ARBs over time was different in females and males. The expected pattern of highest ARBs in EA students and lowest in Asian individuals was most obvious for females and less prominent for males. The mixed-design ANOVA in Table 4 demonstrated significant sex main effects, as well as ethnicity by sex by time and sex by LR by time interactions.

The key role of sex in the rates of ARBs over 55 weeks and the interactions of sex with ethnicity might reflect several mechanisms. First, women develop higher BACs per drink (Baraona et al., 2011; Eng et al., 2005; Rose and Grant, 2010), which may translate into higher risks for ARBs. The differences across ethnicities may be especially strong in women vs. men as Asian and Hispanic women may also have stronger culture-based prohibitions against heavier drinking than seen in EA cultures (Chartier and Caetano, 2009; Nguyen and Neighbors, 2013). Also, while more research is needed, considering recent documentation of potentially genetically-related physiologic characteristics that may relate to the BAC required for ARBs (Silveri et al., 2014; Wetherill and Fromme, 2011; Wetherill et al., 2013, 2012; White, 2004), higher rates of ARBs in EA women might reflect some sex-related biological mechanisms that contribute directly to the ARB risk.

The first part of Hypothesis 3 was also supported in that a low LR was related to higher ARB rates in these subjects. However, the data in Figure 3 indicate that the relationships of ethnicity to ARBs differ in high- and low-LR subjects. It is possible that greater differential in ethnicity-related ARB risks might be observed primarily in subjects with higher LRs where drinking quantities are not already elevated by a low sensitivity to alcohol.

Finally regarding hypotheses, the prediction that the ethnic group status will interact with sex and LR to predict ARB propensity (Hypothesis 4) was partially supported. Table 4 demonstrates significant 3-way interactions for ethnicity by sex by time and sex by LR by time, but the overall 4-way interaction (ethnicity by sex by LR by time) was not significant (p=.12). Still, the findings underscore the contention that there is more to ARBs than just how much a person drinks, and support the prediction that ethnicity, sex and LR all relate to ARB patterns. The optimal understanding of how ARBs develop requires considering a range of characteristics, preferably in a prospective study (Wetherill and Fromme, 2016).

The complex relationships with which multiple factors relate to ARB risks may indicate opportunities for more focused and efficient prevention (Paschall et al., 2011) by identifying subgroups most likely to experience ARBs and who are most likely to gain from programs aimed at decreasing heavy drinking. The larger study from which these data were extracted (Schuckit et al., 2016a) and a smaller investigation at another university (Savage et al., 2015) indicated that active education about alcohol-related risk factors are associated with less intense future drinking. In the current study, the significant active education group vs. control group main effect in Table 4 supports the conclusion that decreases in maximum drinks seen with participation in the educational videos were also associated with lower levels of ARBs over time (Kazemi et al., 2013). Thus, universities and other institutions (e.g., the military) interested in decreasing the risk for ARBs and associated problems might consider developing similar education programs and focusing their efforts on subgroups of subjects with the highest ARB risk.

As is true for all research, it is important to recognize caveats regarding the current work. The data were extracted from a larger study evaluating different ways of decreasing heavy drinking among students, and consistent with a prior report focusing on heavy drinking (Schuckit et al., 2016a), exposure to active intervention affected ARB rates, a factor that complicates interpretation of results. However, as shown in Table 4, the current results remained robust when prevention group assignment was used as a covariate in the mixed-design ANOVA. The relationships among ethnicity, LR and changes in drinking over time are the focus of several other papers and, due to space constraints, are not discussed in detail here (Schuckit et al., 2016a, 2016b). Also regarding the larger study, the subjects were from a single California university, and the generalizability of results to other settings needs to be established, including gathering data on additional ethnic minorities as our analyses were limited to EA, Hispanic and Asian individuals. Next, the data were gathered on-line rather than in person by research staff with whom students had no personal contact, a step that might have affected the veracity of the responses, but the level of impact or direction of effect cannot be determined. Also regarding the larger study from which these data were extracted, to maximize the number of students receiving educational videos only 13% of the subjects were controls, and differences in numbers of subjects across groups may have impacted on current results. While the timeframe for the current study was 55 weeks and the proportion of subjects reporting ARBs during this interval approached 50% in females, ARBs occur over many years and longer term follow ups are needed. In addition, the short time frame of reporting for the prior month for each assessment resulted in relatively low numbers of ARBs per individual per evaluation.

Additional caveats are worth noting. All information about ethnic identity and blackouts involved self-reports, which may underestimate ARBs because heavy drinking can interfere with accurate recognition of whether an ARB occurred. It is also important to recognize that while the SRE has proven to be a robust predictor of future heavy drinking and alcohol problems, the present analyses did not control for years of drinking, the type of beverage consumed or other covariates. However, prior studies demonstrated that the relationship of SRE scores to heavy drinking and related consequences remained robust even after controlling for sex, weight, marijuana use or smoking histories and operated similarly in 12-year-old subjects with recent drinking onsets and in young adults (Schuckit et al., 2016a, 2005). Finally, there are important subgroups among EA, Asian and Hispanic populations, which, reflecting our sample size, could not be evaluated, and additional risk factors associated with ARBs were not included in analyses. These caveats aside, the present findings indicate that the propensity toward ARBs goes beyond the amount of alcohol consumed and is related to interrelationships among ethnicities, sex, and the sensitivity to alcohol.

There are important differences among subgroups of students regarding how characteristics contribute to the ARB risk. Understanding how these interrelationships operate can be important in identifying who carries the highest risk and in creating focused and efficient prevention programs.

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AUTHOR DISCLOSURES

Author: Marc A. Schuckit, M.D.

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Contributors: Dr. Schuckit was the principle investigator who designed the study, supervised the collection, analysis and interpretation of data, played a major role in writing the report and deciding to submit the manuscript.

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Author: Tom L. Smith, Ph.D.

Role of Funding Source: Nothing declared.

Contributors: Dr. Smith was principle statistician on the research project, actively collected, and analyzed the data, and was a major participant in writing the manuscript.

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Author: Priscila Dib Goncalves, Ph.D.

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Contributors: Dr. Dib Goncalves participated in writing of certain sections of paper, in particular the Methods, and assisted in data analyses.

Conflicts of Interest: No conflict declared.

Author: Robert Anthenelli, M.D.

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Contributors: Dr. Anthenelli actively participated in formulating the analytic approach and in writing the article.

Conflicts of Interest: None declared.

AUTHOR DISCLOSURES/CONTRIBUTORS

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AUTHOR DISCLOSURES/CONTRIBUTORS/CONFLICT OF INTEREST STATEMENTS

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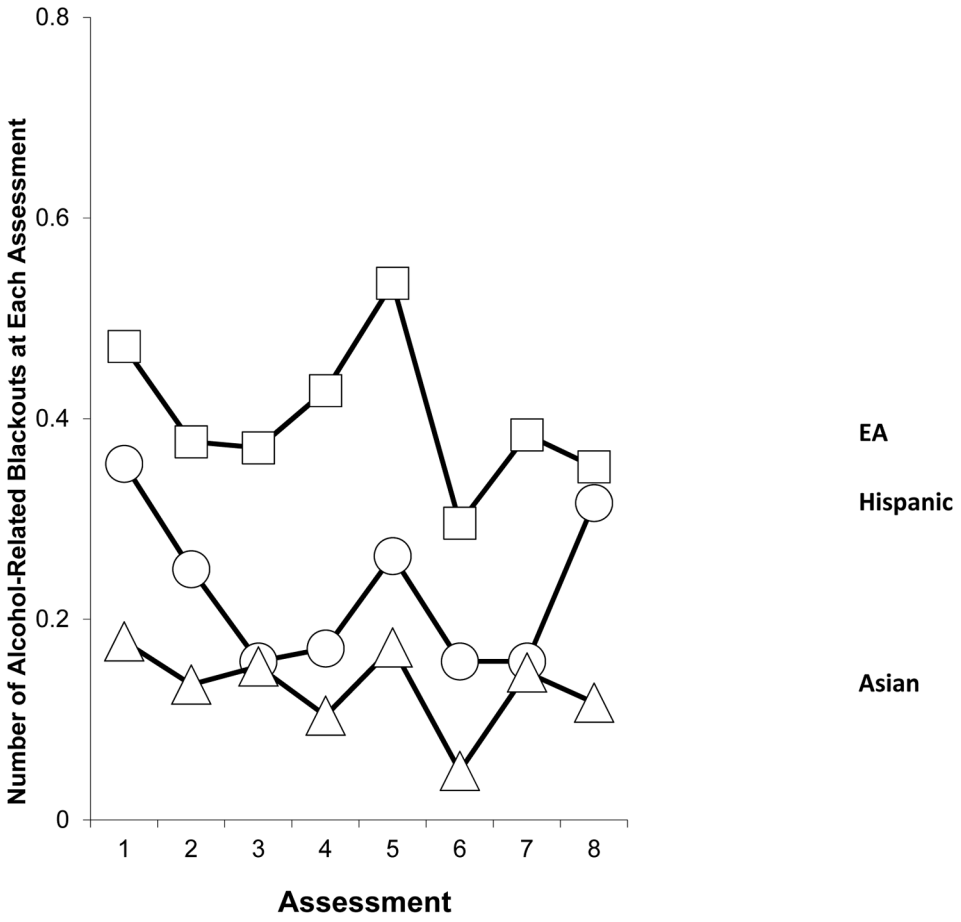
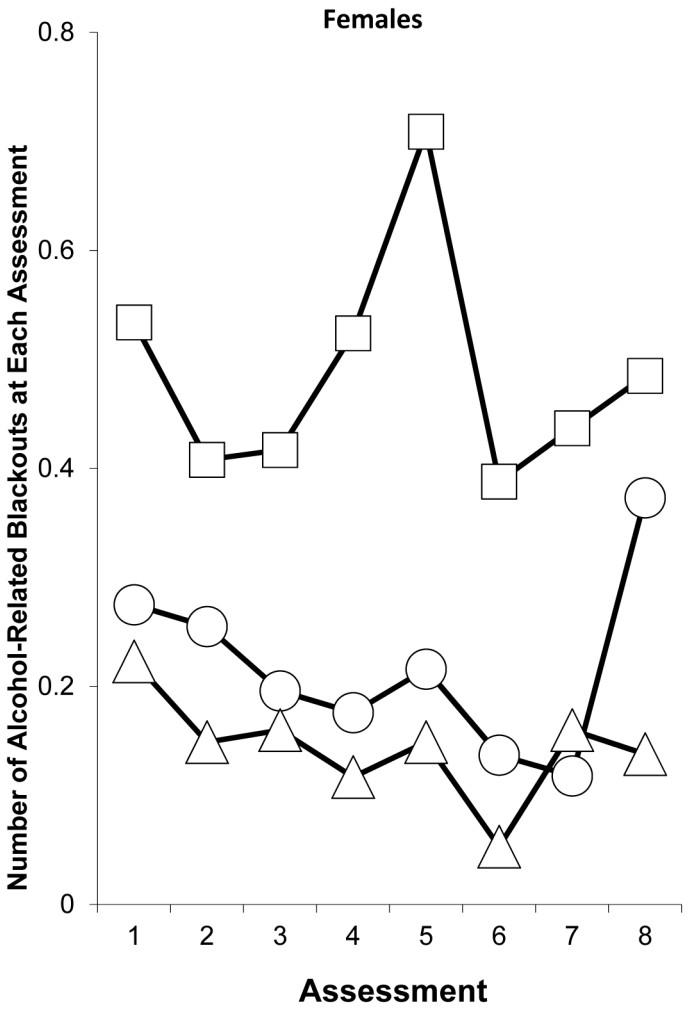


Figure 1.

Number of Alcohol-Related Blackouts the Prior Month at Each of 8 Assessment Times for 398 European American (EA), Hispanic, and Asian Student Drinkers



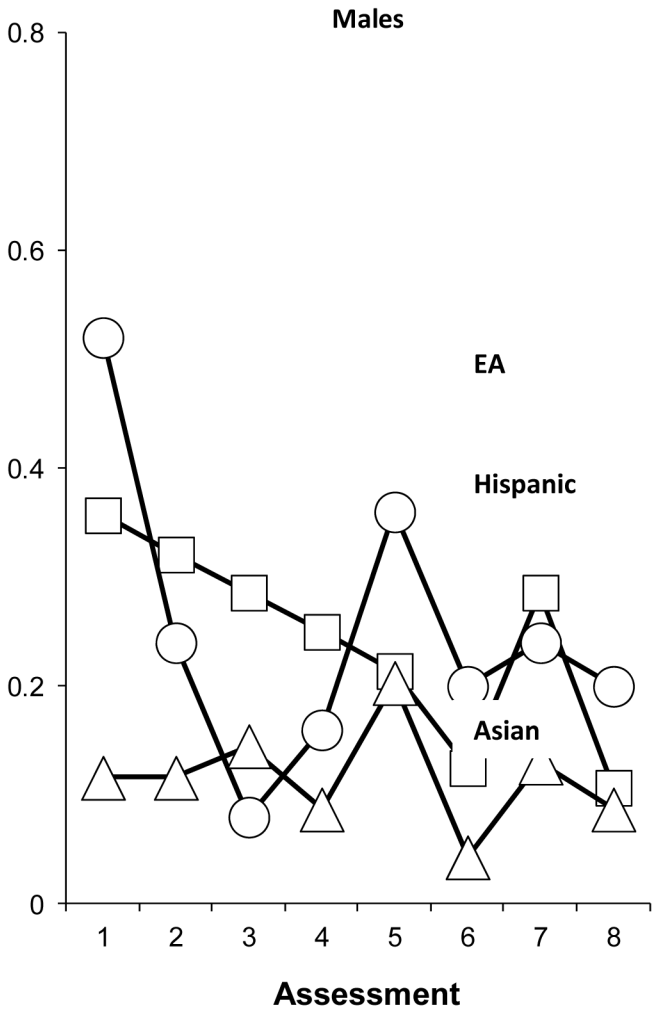
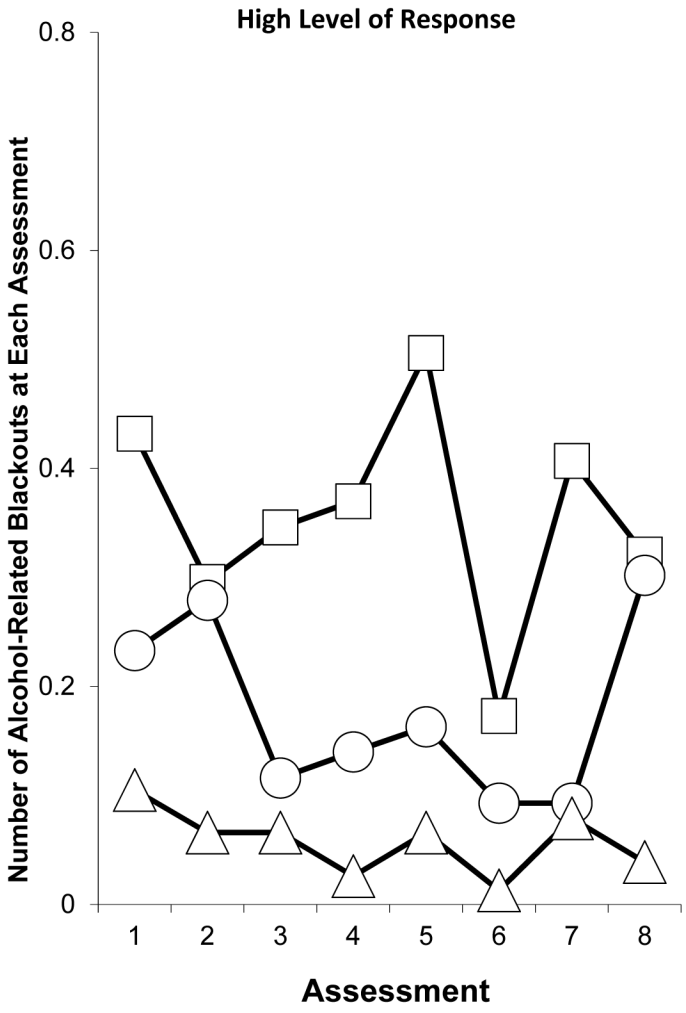


Figure 2.

Within Females and Males: Number of Alcohol-Related Blackouts the Prior Month at Each of 8 Assessment Times for 398 European American (EA), Hispanic, and Asian Student Drinkers



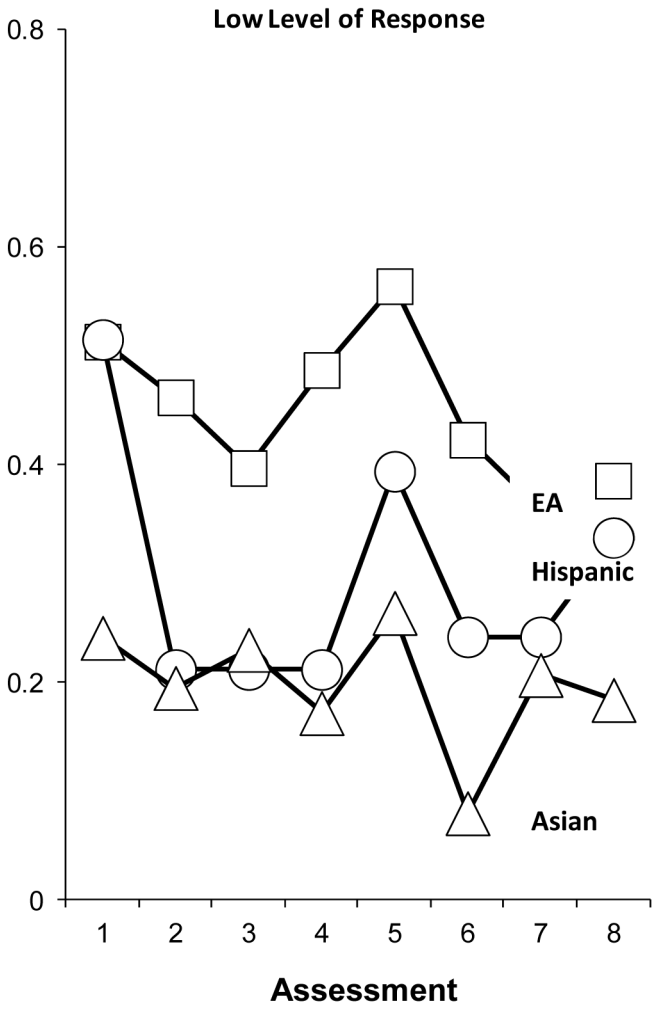


Figure 3.

Within High and Low LR: Number of Alcohol-Related Blackouts the Prior Month at Each of 8 Assessment Times for 398 European American (EA), Hispanic, and Asian Student Drinkers

Table 1

Baseline Characteristics for 398 European American, Hispanic, and Asian Student Drinkers

Baseline Variables	Mean(SD) or %
Demography	
Age	18.1 (0.44)
Female (%)	62.3
Ethnicity (%)	
European American (EA)	39.9
Hispanic	19.1
Asian	41.0
Alcohol	
LR (SRE first 5 times drinking)	4.1 (2.12
Maximum drinks/occasion*	6.4 (4.54)
Usual drinks/occasion*	4.2 (2.76)
Drinking frequency (days/month)*	4.2 (3.89)
Alcohol related blackouts (ARB)*	
1+ARB (%)	21.4
Mean number	0.33 (0.80)
Range	0 to 8
Other Substances	
Any cannabis use (%)*	42.5
Intervention	
Education group assignment (%)	86.7

LR = level of response to alcohol

SRE = Self-Report of the Effects of Alcohol

*prior month

Table 2

Sample Sizes for 398 Student Drinkers Broken Out by Ethnicity, Sex, and Level of Response

Ethnicity	Sex	LR	n
EA	Female	High LR	48
		Low LR	55
	Male	High LR	33
		Low LR	23
Sub-total			159
Hispanic	Female	High LR	30
		Low LR	21
	Male	High LR	13
		Low LR	12
Sub-total			76
Asian	Female	High LR	43
		Low LR	51
	Male	High LR	33
		Low LR	36
Sub-total			163
TOTAL			398

LR = level of response to alcohol

EA = European American

n = sample size

Table 3

Statistics for Figures 1, 2, and 3

Figure 1								
Assessment Time	**Jan (T1)**	**Feb (T2)**	**March (T3)**	**May (T4)**	**June (T5)**	**August (T6)**	**Nov (T7)**	**Feb (T8)**
F	6.56[b]	9.09[c]	5.48[b]	9.90[c]	5.74[b]	4.08[b]	6.87[c]	5.63[b]
F (residual)	1.06	2.98[a]	1.33	3.30[a]	1.30	1.99	1.78	1.47

Figure 2																
	Females								**Males**							
Assessment Time	**Jan (T1)**	**Feb (T2)**	**March (T3)**	**May (T4)**	**June (T5)**	**August (T6)**	**Nov (T7)**	**Feb (T8)**	**Jan (T1)**	**Feb (T2)**	**March (T3)**	**May (T4)**	**June (T5)**	**August (T6)**	**Nov (T7)**	**Feb (T8)**
F	5.05[b]	5.11[b]	4.17[a]	8.44[c]	6.81[c]	3.69[a]	4.21[a]	6.20[b]	2.58	3.58[a]	1.70	1.38	0.06	0.65	2.71	0.86
F (residual)	1.43	1.93	1.71	4.79[a]	3.58[a]	2.20	1.56	4.17[a]	2.18	1.03	0.05	0.08	0.72	0.70	0.42	1.95

Figure 3																
	High Level of Response								**Low Level of Response**							
Assessment Time	**Jan (T1)**	**Feb (T2)**	**March (T3)**	**May (T4)**	**June (T5)**	**August (T6)**	**Nov (T7)**	**Feb (T8)**	**Jan (T1)**	**Feb (T2)**	**March (T3)**	**May (T4)**	**June (T5)**	**August (T6)**	**Nov (T7)**	**Feb (T8)**
F (inverse)	4.18[a]	6.00[b]	5.22[a]	8.10[c]	7.58[c]	3.29[a]	8.23[c]	5.88[b]	2.76	5.40[b]	1.41	3.31[a]	0.07	2.09	0.92	1.68
F (residual)	0.24	1.86	1.72	2.92	2.33	0.85	3.56[a]	1.32	0.92	1.69	0.32	0.91	0.03	2.18	0.39	0.81

T = time of assessment

F = F-test value with inverse transformed dependent variables

F (residual) = F-test value with dependent variables residualized on maximum drinks and education group membership status

Superscripts: a = $p < .05$, b = $p < .01$, c = $p < .001$

Table 4

Evaluating the Number of Alcohol Related Blackouts within a 3 (Ethnicities) by 2 (Sexes) by 2 (LR groups) by 8 (Time) Mixed-Design ANOVA for 398 Subjects

Effect	F-value
Within-Subjects Effects	
Main Effect	
Time	2.21
2-Way Interaction Effects	
Ethnicity x Time	1.73
Sex x Time	0.84
LR x Time	2.78
Education Group x Time	3.26
3-Way Interaction Effects	
Ethnicity x Sex x Time	**3.59**[a]
Ethnicity x LR x Time	0.11
Sex x LR x Time	**4.65**[a]
4-way Interaction Effect	
Ethnicity x Sex x LR x Time	2.16
Between-Subjects Effects	
Main Effects	
Ethnicity	1.94
Sex	**7.86**[b]
LR	0.01
Education Group	**4.37**[a]
2-Way Interaction Effects	
Ethnicity x Sex	2.70
Ethnicity x LR	0.57
Sex x LR	1.43
3-Way Interaction Effect	
Ethnicity x Sex x LR	0.62

For this mixed-design ANOVA, time is the repeated measure, maximum drinks are controlled for at each of the 8 time points, and education group membership was a covariate. F-Values of within-subjects high-order effects and between-subject effects are presented.

LR = level of response to alcohol

Superscripts: a = $p < .05$, b = $p < .01$