The role of social, familial, and individual-level factors on multiple alcohol use outcomes during the first year of university

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Abstract

Background—The first year of university attendance represents a critical time frame for the development of alcohol use and misuse given changes in autonomy and increased access to alcohol. Prior studies have demonstrated that the establishment of drinking patterns during this period is impacted by an array of demographic, environmental, and familial factors. It is critical to consider such factors jointly, and to understand potentially differential effects on stages of alcohol use/misuse, in order to identify robust predictors that may be targeted in prevention and intervention programming.

Methods—As part of a longitudinal study, students at a large, public US university were invited to complete online surveys that included questions related to alcohol use, emotional and behavioral health, environmental factors, sociodemographic factors, and familial environment. The current study uses data from surveys administered in the fall and spring of the first year of university. We used univariate (maximum N=7291) and multivariate (maximum N=4788) logistic and linear regressions to evaluate the associations between potential risk and protective factors with four alcohol use outcomes: initiation, consumption, problems, and addiction resistance.

Results—In multivariate models, we observed associations between demographic, social/ environmental, and personal-level predictors with all four alcohol outcomes, several of which were consistent across each stage of alcohol use. A deviant high school peer group was one of the strongest predictors of risk across outcomes. The influence of drinking motives and alcohol expectancies varied by alcohol use outcome. Externalizing characteristics were associated with

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increased risk across outcomes, while internalizing symptoms were associated with more problems and lower addiction resistance.

Conclusions—These findings underscore the complex network of factors influencing stages of alcohol use during the first year of university. Importantly, these findings demonstrate that the impact of predictors changes across stages of alcohol use/misuse, which presents opportunities for targeted prevention efforts.

Keywords

college drinking; alcohol problems; alcohol addiction resistance; externalizing

Introduction

Alcohol use and misuse constitute an important public health issue, as excessive alcohol consumption cost the US nearly $250 billion in 2010 via reductions in workplace productivity, health care expenses, and criminal justice costs (Sacks et al., 2015). Alcohol use and problems are quite common: over 50% of US adults report drinking within the past month (SAMHSA, 2014); 6.7% report heavy drinking in the past month (SAMHSA, 2014); and nearly 30% of adults meet criteria for a lifetime DSM-5 diagnosis of Alcohol Use Disorder (AUD) (Grant et al., 2015). Pathways leading to AUD are complex and diverse, consisting of familial factors (both biological and otherwise), environmental influences, and psychological and other individual-level factors (Kendler et al., 2011, Edwards et al., 2016, Jessor, 1991). Furthermore, the effects of these factors may differ between alcohol use outcomes, including initiation, typical consumption, problems, and alcohol addiction resistance. Clarification of the unfolding of risk across development is essential to the design and implementation of effective education, prevention, and intervention policies.

Emerging adulthood represents a critical time frame during which many individuals establish patterns of alcohol use/misuse. Although alcohol use initiation typically occurs earlier in adolescence – the median age of onset among US youth is ~14.5 (Chen et al., 2015) – the transition to young adulthood has been associated with increased risk of alcohol use and misuse (White et al., 2006). Individuals who attend college during this period are of particular interest, as research has demonstrated that college students consume more alcohol and engage in riskier drinking behaviors than their non-college attending peers (SAMHSA, 2014). College students report that alcohol use has academic consequences (Wechsler et al., 1998), and many students experience alcohol-related physical or sexual assault (Hingson et al., 2005), underscoring the importance of understanding factors contributing to alcohol use/misuse among this vulnerable population.

Risk factors for the various alcohol use outcomes extend across multiple levels including social-demographic, environmental, personality, and mental health influences, among many possible others (Jessor, 1991, Jessor et al., 2006). More specifically, longitudinal evidence has demonstrated that males and Whites have higher levels of alcohol use and heavy drinking across late adolescence and into young adulthood (Chen and Jacobson, 2012). The influence of family socioeconomic status (SES) is mixed. Parental income and education is positively associated with drinking frequency and binge drinking, but negatively related to

alcohol-related problems during late adolescence (Kendler et al., 2014). Finally, among environmental influences, parental involvement and peer substance use/peer deviance have emerged as consistent predictors of alcohol use and misuse during adolescence (Sher et al., 2005). Additionally, a family history of alcohol problems is predictive of alcohol problems during young adulthood (Kendler et al., 2011, Edwards et al., 2016), though this combines both genetic and environmental risk.

Individual level factors also play a role in risk for alcohol use outcomes. Personality factors such as elevated disinhibition, low conscientiousness, and low agreeableness are related to substance use disorders more broadly (Kotov et al., 2010). For alcohol use specifically, personality factors related to impulsivity, including sensation seeking, and positive urgency significantly increase risk for both alcohol consumption and problematic use (Stautz and Cooper, 2013). Along with personality factors, other mental/behavioral problems such as depression and anxiety disorders show significant overlap with alcohol and other substance use disorders (Grant et al., 2004), suggesting these may increase risk of alcohol misuse. Beyond personality and other mental health characteristics, individual motives for drinking alcohol, especially drinking for enhancement or social facilitation, increase the likelihood of alcohol use among college-aged students (Kuntsche et al., 2006, Borsari et al., 2007). In short, the risk factors for alcohol related outcomes are diverse, extending across multiple levels and developmental periods.

Addiction resistance (Kendler and Myers, 2015), is a relatively novel construct informed by the study of psychiatric resilience to stressful life events (Amstadter et al., 2014), defined as the individual variation in sensitivity to substance use disorder (SUD) symptoms based on a given rate of consumption. Falling along a spectrum, individuals high in addiction resistance endorse lower than predicted SUD symptoms, while individuals low in addiction resistance report higher than expected SUD symptoms given their level of consumption. Importantly, although high addiction resistance may be protective against the development of a SUD, it should not be considered as a uniformly advantageous trait. Individuals with high addiction resistance remain at risk for long-term health consequences, such as cirrhosis, cancer, liver disease, and heart disease for heavy alcohol users (World Health Organization, 2014). Accordingly, the subset of heavy users who are high in addiction resistance may require unique clinical considerations, as they may be less likely to observe cues to action that encourage reduction or cessation of their substance use. Studying predictors, correlates, and outcomes associated with addiction resistance may prove beneficial in furthering understanding risk on both ends of the spectrum, identifying opportunities for clinical interventions that better speak to the experiences of those with high and low addiction resistance, and informing public health initiatives focused on combatting the physical health consequences of heavy alcohol consumption.

In the current study, we capitalize on the availability of extensive phenotypic data to examine the effects of diverse predictors on alcohol use, misuse, and addiction resistance, during the first year of college. The comprehensive nature of these analyses enables us to explore risk in a contextually realistic manner, rather than being limited to a "silo" perspective that focuses on only one or two aspects of risk. This perspective is consistent with the broad "deviance prone" model (Sher, 1991, Jessor, 1991), which proposes that

various factors – family history, peer relationships, personality, etc. – build on each other in the development of alcohol misuse by conferring risk towards problem behavior. The present study is not the first to consider joint impact of various risk and protective factors on college substance use (Durkin et al., 2009, Sher and Rutledge, 2007, White et al., 2006, Jessor et al., 2006). However, compared to these previous studies, the current sample is much larger (N=7603), representative of the university student body (67% of eligible students participated), and covers a broader range of known predictors of young adult alcohol use. Furthermore, the consideration of multiple alcohol use outcomes provides the opportunity to explore whether predictors' impact varies across the progression of alcohol use: e.g., do specific environmental factors impact only alcohol use initiation, or do they remain relevant for later stages of use such as alcohol problems? We investigate these questions in a diverse sample of university students, as emerging adulthood represents a critical time frame for the development of drinking habits, and the college environment presents unique opportunities for alcohol use.

Materials and Methods

Sample

The Spit for Science study consists of college students attending a large, public university in an urban area in the eastern US, and has been described previously (Dick et al., 2014). Briefly, in the weeks prior to the fall of their freshman year, all incoming students aged 18 or older were sent information about the project and an invitation to complete an online survey about behavioral and emotional health and substance use. A follow-up survey was conducted in the spring, and students who did not participate in the fall were eligible to join the study at that point, in which case they completed a slightly modified version of the spring survey. Study data were collected and managed using REDCap electronic data capture tools hosted at Virginia Commonwealth University (Harris et al., 2009). The current study focuses on alcohol use outcomes in the first year of college for the first three cohorts enrolled in the study (N=7603).

Analyses

Analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC). Variables were standardized using PROC STANDARD. Logistic and linear regressions were carried out including sex, age, and cohort as covariates, along with the predictor(s) of interest. As participants are able to opt out of survey items, the number of responses differs across items. The number of participants included in each analysis is reported in the appropriate table. Variables were pro-rated as necessary (described in Dick et al. (2014)). Briefly, if a participant answered at least half of, but not all, the items for a construct, their responses were scaled according to the number of responses provided.

For multivariate analyses, models were constructed that included all predictors from univariate analyses, as this represents a relatively conservative statistical approach. For the sake of comparison, we also conducted multivariate analyses that only included predictors with p<0.05 in the univariate analyses, and stepwise regressions wherein predictors with

p<0.10 were retained. Results were not substantively changed in these less restrictive models, and we report here the results from the most inclusive multivariate models.

Outcome Variables

Alcohol Use Initiation—In the fall and spring semesters, students were asked whether they had ever had a whole alcoholic drink (not counting a few sips). Those who reported never drinking in the first year were coded 0; otherwise they were coded 1 and were also administered items used to construct the other alcohol outcome variables. Note that even lifetime abstainers had the opportunity to respond to items related to alcohol expectancies, which were used as predictors in the current analyses, since consuming alcohol is not necessary to form expectations about its effects.

Alcohol Consumption—In the fall and spring semesters, participants who reported having initiated alcohol use were asked how often they had a drink of alcohol, with response options ranging from "never" (i.e., they had initiated drinking but did not currently drink) to "4 or more times per week." These responses were converted to values from 0–16 to approximate the number of drinking days per month. Next, participants who had initiated alcohol use and who responded that they currently drank more often than "never" were asked how many alcoholic drinks they had on a typical drinking day, with responses ranging from "1 or 2" to "10 or more." These responses were converted to values ranging from 1.5–10 to approximate the number of drinks consumed per drinking day. The same approach was applied to items administered (in the fall only) that specifically asked about their drinking in the past 30 days, and the drinking days variable and drinks consumed variables were multiplied together. The mean of these products (across three time frames: overall fall drinking, past 30 day fall drinking, and overall spring drinking) was taken, 1 was added, and the value was log-transformed to arrive at the alcohol quantity outcome. The latter two steps were done to normalize the distribution of the alcohol quantity outcome. Individuals who had not initiated alcohol use were coded as 0.

Abuse/Dependence Score—In the fall and spring semesters, participants who reported having initiated alcohol use were administered survey items that corresponded to DSM-IV Alcohol Abuse and Alcohol Dependence criteria. Participants reported whether they had experienced each criterion "Never," "1–2 times," or "3 or more times." For the current analyses, each of the 11 criteria were coded 1 if the participant reported ever having experienced the criterion; otherwise they were coded 0. For those who reported having used alcohol regularly or having been drunk, sum scores were calculated (alpha fall = .844, alpha spring = .820). The mean of the sum scores across the two semesters of the first year was used as the abuse/dependence score outcome variable.

Alcohol Addiction Resistance—This variable is based on the concept of psychological resilience (Kendler and Myers, 2015). It is operationalized as the deviation from the number of expected symptoms of alcohol problems based on the maximum reported alcohol consumption (i.e., the residual). The residual is then multiplied by −1 so that a value greater than 0 represents a positive outcome (fewer symptoms of alcohol problems than expected). As this measure incorporates symptoms of abuse/dependence, it is only available for

participants who were administered those items (i.e., those who reported regular drinking or having been drunk).

Predictors

Demographic Variables—In addition to age, sex, and cohort, which were included in all analyses, the following demographic variables were assessed: self-reported race/ethnicity, with "white" used as the reference group; parental educational attainment, which was coded as the mean of educational attainment of the two parental figures; and living situation up to age 6, between ages 7–12, and between ages 13–18, which provided information about parental marriage status and whether the participant grew up in a single-parent household; and current college housing arrangement, including with parents, off-campus but not in the parents' home, or in on-campus housing, which was the reference category as most participants fell into this group.

Family History—The first time they completed the survey, participants were asked whether they thought their parents, siblings, aunts, uncles, or grandparents (biological only) had ever had problems with alcohol, other drugs, or with depression/anxiety. Each participant was given a score based on the number of relative types (mother, father, sibling, or other) they endorsed having a problem for each category (alcohol, drug, or depression/ anxiety).

Personality—Personality was measured using a subset of items from the Big Five Inventory (John and Srivastava, 1999). Only the items that were administered in both the fall and spring surveys were included in the current analyses, which corresponded to three items each for openness (is original, has an active imagination, values artistic, aesthetic experiences, alpha=.638), conscientiousness (does a thorough job, is a reliable worker, does things efficiently, alpha=.714), extraversion (is talkative, tends to be quiet, is outgoing, sociable, alpha=.792), agreeableness (is helpful, is considerate, is sometimes rude to others, alpha=.599, and neuroticism (handles stress well, worries a lot, is not easily upset, alpha=. 689).

High School Antisocial Behavior—Participants were administered six items measuring how often they exhibited antisocial behavior (skipping school, running away from home, stealing, using a weapon in a fight, robbing someone, starting physical fights) during the past year of high school. A sum score was created to operationalize the frequency of these behaviors (alpha=.527).

Perceived Peer Deviance—Participants were administered 6 items related to perceived deviant behavior among friends they saw regularly and spent time with in or outside of high school during the past year. The items asked what proportion of their friends (ranging from "none" to "all") engaged in behaviors such as drinking alcohol, smoking cigarettes, getting drunk, getting in trouble with police, smoking marijuana, and having problems with alcohol. A sum score was created to operationalize the participant's exposure to deviant peer behavior (alpha=.890).

Personal Devotion—The survey included 2 items asking about the importance of spiritual beliefs in participants' lives, ranging from "not at all important" to "very important" and how often they seek spiritual comfort when they have problems, ranging from "never" to "almost always."(Kendler et al., 1997) Responses were summed.

Social Support—Participants responded to 3 items assessing the availability of a social support system, e.g., how often (ranging from "none of the time" to "all of the time") someone was available for advice, relaxation, or to talk about problems (Hays et al., 1995). Responses were summed (alpha=.839).

Exposure to Natural Disaster—Participants were asked whether they had experienced a flood, hurricane, tornado, etc., prior to coming to the university.

Symptoms of Anxiety and Depression—Participants were administered a subset of items from the Symptom Checklist (SCL, (Derogatis et al., 1973)) to assess symptoms of anxiety and depression experienced during the preceding 30 days. For these analyses, 4 items were used for anxiety (alpha=.820) and 4 for depression (alpha=.799). A sum score was used to operationalize the frequency of symptoms.

Self-Rating of the Effects of Alcohol (SRE)—Participants who reported that they had drank alcohol on at least 5 occasions were administered the SRE (Schuckit et al., 1997) with respect to the first 5 or so times they drank (alpha=.868). The SRE provides a measure of how sensitive an individual is to ethanol at the onset of drinking. The score was calculated as recommended by Schuckit et al. (1997).

Alcohol Expectations—All participants (even those who were lifetime abstainers) were administered 10 items related to alcohol expectations, which represented a subset of items from previously defined scales (Fromme et al., 1993). Six subscales were assessed: cognitive and behavioral impairment (feeling dizzy or clumsy), liquid courage (would be brave and daring or courageous), self-perception (would feel guilty or moody), sexuality (would be a better lover), sociability (would act sociable), and tension reduction (feeling peaceful or calm). Each item was rated on a scale of "Disagree" to "Agree" with item scores being summed within a subscale.

Drinking Motivations—Individuals who reported any lifetime drinking were administered 12 items, based on previously defined scales (Cooper, 1994) to assess their drinking motives. The four subscales assessed were coping (to cheery myself up or it helps when I feel nervous/depressed, alpha=.901), conformity (to be liked, so that others won't kid me, to get in with a group I like, alpha=.858), enhancement (it's fun, it gives me a pleasant feeling, because I like the feeling, alpha=.864), and sociality (it helps me enjoy a party, makes social gatherings more fun, improves parties, to celebrate a special occasion with friends, alpha=.883). Each item was rated on a scale of "Strongly Disagree" to "Strongly Agree". Related items were then summed to create each subscale.

Results

Descriptive statistics

Demographic details for the full sample of 7603 individuals are provided in Table 1. Sample sizes available and average scores for each alcohol outcome are described in Table 2. Of those who responded to the items regarding alcohol use initiation (N=7476), 82.8% (N=6191) indicated that they had tried at least one full drink of alcohol. Due to observed sex differences, sex was included as a covariate in all analyses.

Univariate Analyses

We first tested whether each predictor was associated with each of the four alcohol outcomes (alcohol use initiation, alcohol consumption, problems, and addiction resistance). The associations between drinking motivations and SRE scores with initiation was not assessed because only participants who had initiated alcohol use were administered the relevant items. Results are presented in Table 3. The reported p-values have been adjusted for multiple testing using the Benjamini-Hochberg correction. Nearly every predictor was associated with one or more alcohol outcome; only self-reported Hispanic race/ethnicity and living off campus were not associated (p>0.05) with any outcome (where White race/ethnicity and on-campus housing were the references, respectively).

Multivariate Analyses

We next tested which predictors were associated with each alcohol outcome when all variables were included in the model (Table 4). Note that our use of the terms "protective" and "risky" below are not meant to imply causality, only direction of association. Streamlined results for predictors with effect sizes >0.1 are presented in Table 5. We observed that students who self-reported as White had riskier drinking outcomes than their peers, though these effects were not systematic across outcomes or within minority ethnicities. Students who currently resided with their parents were less likely to have initiated alcohol use, consumed less alcohol overall, and had fewer problems.

A family history of alcohol problems was associated with a higher rate of initiation and more problems. However, a family history of problems with other substances was associated with lower alcohol consumption. Students with a family history of depression were less likely to have initiated alcohol use.

Antisocial behavior during high school was robustly associated with higher rates of initiation, higher consumption, more problems, and lower alcohol addiction resistance; similarly, extraversion was associated with all but alcohol addiction resistance. Conscientiousness and openness were more sporadically associated with different outcomes, and were protective. Personal religious devotion was negatively associated with initiation and consumption; however, it was also associated with lower levels of addiction resistance. Symptoms of anxiety, but not depression, were associated with higher levels of consumption and lower addiction resistance.

With respect to environmental factors, having a deviant peer group during high school was positively associated with all 4 outcomes and represented one of the strongest predictors of risk. Higher social support, on the other hand, was weakly protective against high consumption and was associated with higher addiction resistance.

The effects of alcohol-related factors – SRE score, alcohol expectations, and drinking motives – remained broadly influential in the multivariate analysis. Higher SRE scores, indicative of low initial sensitivity to alcohol, were associated with higher consumption and problems. Expectations that drinking would improve sociability and enhance sexuality were positively associated with alcohol use initiation; both "liquid courage" and sexuality expectations were associated with high consumption; and "liquid courage" was associated with more problems. The effects of expectations of tension reduction were complex: they were positively associated with initiation, but were associated with lower consumption and higher addiction resistance. Expectations that alcohol use would result in cognitive and behavioral impairment were broadly protective: they were associated with lower rates of initiation, lower consumption, and fewer problems. The perception that drinking would result in a negative impact on one's self-perception was protective against initiation, but associated with higher problems and lower addiction resistance. The effects of drinking motives were varied: those who reported drinking to increase sociality consumed more alcohol; students who reported drinking to cope also reported higher problems and had lower addiction resistance; and those who drank to enhance positive experiences consumed more and had more problems.

Discussion

The current report describes our effort to identify factors influencing normative and problematic alcohol use, along with alcohol addiction resistance, among a diverse sample of first-year college students. We included as potential predictors a range of demographic variables, family history, non-familial environmental factors, and individual-level characteristics including alcohol expectancies and drinking motives. We found that across all outcomes, high school antisocial behavior and a deviant high school peer group are strongly and consistently associated with poorer outcomes. However, these predictors did not act in isolation, as familial and demographic factors, as well as individual-level constructs, were also associated with each stage of the progression to alcohol problems or resistance. These analyses help to clarify the complex network of shifting influences relevant to alcohol use and misuse during a developmental period of particular interest due to its centrality in the establishment of future alcohol use patterns (Del Boca et al., 2004). Below, we detail our most robust findings and highlight the effects of predictors on different alcohol use outcomes.

First, we found strong support for the role of externalizing features (high school antisocial behavior and affiliation with deviant peers): these predictors were robustly associated with higher risk for all four alcohol outcomes. The emergence of a prominent association between externalizing features and alcohol outcomes is consistent with previous studies (Edwards et al., 2016, Fergusson et al., 2007, Kendler et al., 2011). Several of these studies (Kendler et al., 2011, Edwards et al., 2016, Fergusson et al., 2007) similarly included risk factors

representing an array of constructs (e.g., family history, environmental factors, personality, etc.), demonstrating that the observed association is robust to the inclusion of other critical predictors.

Having a deviant high school peer group was one of the most strongly implicated risk factors across all four alcohol outcomes. Such an association has been observed previously (Kendler et al., 2011, Edwards et al., 2016, Curran et al., 1997, Duncan et al., 1998). We conceptualize this finding as being part of the externalizing pathway to alcohol use/misuse, consistent with prior models (Kendler et al., 2011, Edwards et al., 2016, Sher et al., 2005). Peer deviance can exacerbate genetic liability for alcohol misuse (Salvatore et al., 2014, Cooke et al., 2015), underscoring the interdependence of risk factors. The relation between peer deviance – to include underage alcohol use – and alcohol outcomes is complex: the reciprocal forces of social selection and social influence impact alcohol and other substance use (Caspi, 2002). Further analyses in the Spit for Science sample can explore such questions using prospectively assessed data.

Influences Consistent Across Progression to Alcohol Problems

Several predictors were found to be either consistently protective or risk-conferring from alcohol initiation to consumption and ultimately alcohol problems, but were not associated with addiction resistance. Currently living with one's parents had the largest protective effect on alcohol consumption and problems. Living at home during college may provide a buffer against students' selection into pro-alcohol peer groups (White et al., 2008), which as discussed above may have a pronounced effect on alcohol misuse. Although exhibiting a strong effect across initiation, consumption and problems, there was no association with addiction resistance, suggesting a unique protective effect of parents on the progression to the specific negative outcome of alcohol problems but without conferring a protective effect for the more nuanced outcome of higher addiction resistance.

Extraversion was positively associated with increased alcohol initiation, consumption and problems, consistent with some (Edwards et al., 2016, Ibanez et al., 2015) but not all (Littlefield et al., 2010) previous findings. Previous work suggests that this association may be related to drinking motives (Kuntsche et al., 2006) or expectancies (Ibanez et al., 2015). Although overall the literature on negative alcohol expectancies (such as cognitive or behavioral impairment) is mixed, indicating there may be differing effects of specific expectancies on drinking stage, the current finding mirrors results from Nicolai et al. (2010) who found a similar effect in both student and clinical samples.

Predictors of Normative Alcohol Use Outcomes (Initiation/Consumption)

While all of these predictors have been previously studied and most have been previously associated with alcohol outcomes, a unique strength of the current project is the ability to examine (in the context of multiple predictors) which have a specific effect on the more normative end of alcohol use. Alcohol expectations of sociability and sexuality are significantly associated with alcohol initiation and consumption but not with problematic drinking or addiction resistance. Previous studies have demonstrated that positive expectancies and motives regarding alcohol lead individuals to drink and to consume more

(Li and Dingle, 2012, Ham et al., 2005). This fits with Expectancy Theory, which proposes that expectancies about the outcomes of a behavior affect the likelihood of engaging in that behavior (Goldman et al., 1999). Therefore, positive expectancies about alcohol are likely to result in increased alcohol use as observed here.

Predictors with Concordant Effects on Alcohol Problems and Addiction Resistance

Several factors predicted only alcohol problems or addiction resistance, with concordant directions of effect: conscientiousness, social support, anxiety, and drinking to cope. The negative relationship between conscientiousness and alcohol problems is supported by a recent meta-analysis (Malouff et al., 2007). Furthermore, Littlefield et al. (2010) demonstrated that increases in conscientiousness were associated with decreases in alcohol problems over time and that this relationship was mediated by changes in drinking to cope motives.

We observed a modestly protective effect of social support on both alcohol problems and addiction resistance, indicating that peer associations can also have a positive impact on these end stage outcomes in young adults. This is largely consistent with previous research. For example, within the National Epidemiological Survey on Alcohol and Related Conditions, lower levels of support were modestly associated with more alcohol problems (Moak and Agrawal, 2010). However, research has been mixed when examining the relationship between social support and alcohol consumption (Allgöwer et al., 2001, Peirce et al., 2000), with which we did not observe an association. These inconsistencies may be attributable to the changing role of social support at different stages of alcohol use: students may only call upon social support resources, or the support system may only intervene, as their alcohol use behavior exceeds normative outcomes and becomes problematic.

Finally, symptoms of anxiety and drinking to cope were associated with more alcohol problems and lower addiction resistance; in other words, while individuals who reported higher anxiety and levels of drinking to cope did not consume more than their peers, they experienced more problems than expected given their consumption. The effect sizes of these internalizing features on alcohol problems were reduced relative to externalizing features (such as antisocial behavior and peer deviance, discussed above). Thus, internalizing characteristics' relationship to trajectories of alcohol use/misuse differs from that of externalizing behaviors, the latter of which impact stages of alcohol use that precede the development of problems. This is well supported in the literature, as internalizing symptoms (including anxiety) are more often associated with more serious stages of alcohol outcomes, such as alcohol problems (Cooper, 1994, Kenney et al., 2015). Further research suggests that drinking to cope is more directly related to risky drinking than are negative moods (Cooper et al., 1995), and that this pathway may be more pronounced among women (Kenney et al., 2015).

Predictors that Differentiate Alcohol Problems and Addiction Resistance

Of the factors that impacted alcohol problems but not addiction resistance, we will highlight two: SRE and enhancement drinking motives. The observed differences help illuminate addiction resistance as a qualitatively different alcohol outcome than merely experiencing

few alcohol problems. For example, associations between drinking for enhancement and alcohol consumption and problems are well documented in the literature (Carpenter and Hasin, 1998, Cooper, 1994). However, its lack of association with addiction resistance demonstrates that those who endorse enhancement drinking motives experience problems consistent with their alcohol consumption. This contrasts with drinking to cope and liquid courage predictors, in that individuals endorsing those motives/expectancies not only exhibit more problems but that their degree of problems is disproportionate to their level of consumption.

Similarly, SRE was associated with greater consumption and problems but not with addiction resistance. This association is consistent with previous findings (Schuckit et al., 2007), and suggests that individuals who have a higher tolerance for alcohol when they first begin drinking are likely to drink more than their peers in order to attain the same effects. The association with problems but not with addiction resistance in the multivariate model demonstrates that individuals with low initial sensitivity to alcohol cannot drink with impunity; that is, although they perceive their response to alcohol as being low, they do not experience fewer problems than expected based on their consumption. There is prior evidence that SRE is genetically influenced (Schuckit et al., 2003), and indeed it is a stronger predictor than family history of alcohol problems for both consumption and problems in the current study.

Factors with Varying Direction of Effect

Perhaps the most intriguing findings were that some factors changed their direction of influence across stages of alcohol use. Personal devotion and the expectation that alcohol would negatively affect your self-perception were protective for the normative alcohol use outcomes (less likely to initiate use and lower consumption) but associated with increased alcohol problems and lower addiction resistance. In contrast, the expectation that alcohol would reduce tension was associated with increased likelihood to use alcohol but with fewer alcohol problems and greater addiction resistance.

Previously reported discrepancies in the effects of negative alcohol expectancies are reflected in our analyses by the alcohol expectancy of negative self-perception. Reflective of the belief that drinking alcohol would cause a person to feel guilty or moody, negative self-perception is intuitively protective against alcohol initiation. Similar findings have been demonstrated with alcohol consumption (Ham et al., 2012, Ham et al., 2005). More surprisingly, this expectation is associated with more alcohol problems and lower addiction resistance. This finding contradicts previous literature, which used a combined measure of multiple negative alcohol expectancies and found a negative relationship with problem alcohol use (Zamboanga et al., 2009).

Higher levels of personal devotion were protective against initiation and consumption. This is consistent with prior findings demonstrating negative associations between various dimensions of religiosity and both consumption and problems (Kendler et al., 2003, Miller et al., 2000). In a previous study using the current sample, personal devotion was negatively associated with peer group deviance (Kendler et al., 2015), raising the possibility that peer group mediates the negative associations observed in the current study. Given the relative

novelty of the addiction resistance phenotype, it is difficult to contextualize the finding that personal devotion had a "risky" effect on that outcome. Future studies may explore whether this effect was driven by particular aspects of problems: perhaps devoted individuals endorse items related to alcohol's impact on their relationships/family, but not those related to hazardous use, tolerance, or withdrawals given their overall lower consumption.

Limitations

We note a number of methodological limitations to these analyses. First, alcohol use initiation frequently occurs prior to college matriculation, and given a somewhat nonspecific timeframe for some variables (e.g., exposure to natural disasters, high school peer deviance), the temporal order of "predictor" and "outcome" might be inverted. Second, some predictors may be sensitive to recall bias as they were not prospectively assessed. Third, multivariate analyses consisted of a reduced number of participants relative to univariate analyses due to participants' ability to skip individual items. Given the consistency of our findings with the extant literature, it is unlikely that this resulted in biased results. Fourth, we did not impose a multiple testing correction at the multivariate level as the four multivariate models involved correlated outcomes. However, we recognize that multicollinearity within each multivariate model may explain a change in direction or magnitude of effect for some of the predictors from the univariate to multivariate models. The best example of this being the protective effect of a family history of depression or drug problems on alcohol initiation and consumption in the multivariate models, though inspection of the variance inflation factor (VIF) for predictors in the multivariate model suggested that multicollinearity was not an issue. Fifth, in order to maximize the diversity of information collected while minimizing participant burden, the number of items in each scale was reduced. Therefore, the internal reliability of some of the scales (such as personality) are lower than ideal. Finally, our measure of alcohol problems is somewhat liberal, as individuals could respond that they had experienced a given AUD criterion only once and that would contribute to a non-zero problems score. Even with this more liberal cutoff alcohol problems, the variable is slightly skewed (1.36) and we acknowledge that while transforming this variable could potentially yield different results. In addition, the clinical significance of any endorsed problems is unknown. However, given that even low levels of problems experienced during this developmental time frame can be predictive of more severe outcomes later in adulthood, our approach is relevant to the clarification of risk factors.

Summary

We report on the effects of a wide variety of potential risk and protective factors for alcohol use and misuse during the first year of university attendance, a critical time frame for the establishment of drinking habits and potentially the emergence of problems. Demographic, environmental, familial, and individual-level factors all broadly impacted different alcohol outcomes. We observed strong support for an association between externalizing behaviors and alcohol use across all outcomes, as well as more modest support for an association between internalizing symptoms and problems or lower addiction resistance. The current results support the assertion that the various factors associated with alcohol outcome do not act in isolation or consistently across stages of use. These findings provide a framework for refined analyses exploring mediation and moderation among implicated risk factors, and for

the development of educational and prevention programming to reduce risky alcohol outcomes among college students.

Acknowledgments

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Table 1

Sample demographics.

Sample Description	N	Self-Reported Race/Ethnicity	N (%)
Cohort 1	2714	American Indian/Alaska Native	35 (0.5%)
Cohort 2	2486	Asian	1223 (16.1%)
Cohort 3	2403	African American/Black	1464 (19.3%)
Total	*7603*	Hispanic/Latino	450 (5.9%)
		More than one race	467 (6.1%)
% Female	61.1	Native Hawaiian/Other Pacific Islander	50 (0.7%)
Mean (SD) age at first wave of data collection	18.5 (0.64)	White	3763 (49.5%)
		Unknown/Chose not to answer	151 (2%)

Table 2

Sample sizes for alcohol outcomes.

Outcome	N	Mean (SD)	Sex	2	3
1. Alcohol use initiation	7476	n/a	p=0.12		
2. Monthly consumption	7329	13.1 (21.8)[1]	p<0.0001[2]		
3. Alcohol problems	6122	2.0 (2.18)	p=0.0018[2]	0.5050*	
4. Alcohol addiction resistance	5915	0.0 (0.76)	p<0.0001[2]	−0.0010	−0.7814*

[1]Prior to log transformation as described in Methods

[2]Higher among men

Table 3

Results from univariate analyses for each of four alcohol outcomes.

Predictor	Alcohol Use Initiation			Alcohol Consumption			Alcohol Problems			Alcohol Addiction Resistance		
	OR	p[1]	N	Beta	p[1]	N	Beta	p[1]	N	Beta	p[1]	N
Demographics[2]												
American Indian	1.0022	0.9478	7270	−0.003	0.8651	7133	0.0712	0.0164	5968	−0.0336	0.0022	5776
Asian	0.6904	<0.0002	7270	−0.2481	<0.0002	7133	−0.1811	<0.0002	5968	0.0132	0.2725	5776
African American	0.896	0.0004	7270	−0.1686	<0.0002	7133	−0.1837	<0.0002	5968	0.0146	0.1987	5776
Hispanic	1.0586	0.1171	7270	0.0042	0.8472	7133	−0.0188	0.5516	5968	−0.0052	0.6632	5776
Multiethnic	1.1171	0.0033	7270	0.0156	0.4399	7133	0.0166	0.5902	5968	−0.0141	0.1987	5776
Pacific Islander	1.0073	0.8651	7270	0.0151	0.4399	7133	0.0559	0.0562	5968	−0.0266	0.0132	5776
Unknown Race/Ethnicity	0.9869	0.7304	7270	−0.024	0.1931	7133	0.0579	0.0562	5968	−0.0305	0.0049	5776
Height	1.2658	<0.0002	7302	0.1958	<0.0002	7164	0.1361	0.0008	5992	0.0136	0.3790	5796
Weight	1.1216	0.0019	7288	0.0163	0.4399	7155	−0.0465	0.1595	5972	0.0302	0.0105	5781
Parental Education	1.0486	0.1588	7249	0.1013	<0.0002	7109	0.1412	<0.0002	5954	−0.0137	0.2219	5762
Off-Campus Housing	1.0025	0.9478	5898	0.0127	0.5574	5772	0.0615	0.0562	4882	−0.0232	0.0528	4735
Currently Live with Parents	0.8221	<0.0002	5898	−0.1805	<0.0002	5772	−0.1504	<0.0002	4882	0.0206	0.1084	4735
2-Parent Household During Preschool	0.9228	0.0234	7291	0.0138	0.4758	7150	0.0433	0.1449	5981	−0.0013	0.9416	5787
2-Parent Household During Elementary School	0.8951	0.0016	7288	−0.0034	0.8604	7147	0.0328	0.2673	5980	−0.0005	0.9571	5786
2-Parent Household During High School	0.8945	0.0014	7277	−0.0212	0.2700	7136	−0.0007	0.9789	5973	0.0009	0.9541	5779
Family History												
Alcohol Problems	1.6229	<0.0002	7212	0.2561	<0.0002	7085	0.3753	<0.0002	5917	−0.1004	<0.0002	5736
Drug Problems	1.4834	<0.0002	7210	0.197	<0.0002	7079	0.3543	<0.0002	5914	−0.1061	<0.0002	5730
Depression	1.3527	<0.0002	7115	0.2208	<0.0002	6990	0.4025	<0.0002	5845	−0.1067	<0.0002	5671
Personality & Behavior												
High School Antisocial Behavior	2.4918	<0.0002	7283	0.5072	<0.0002	7147	0.8157	<0.0002	5976	−0.1886	<0.0002	5786
Extraversion	1.4547	<0.0002	7327	0.3487	<0.0002	7187	0.2784	<0.0002	6006	−0.01	0.3790	5809
Agreeableness	0.8523	<0.0002	7328	−0.1429	<0.0002	7187	−0.2696	<0.0002	6010	0.0671	<0.0002	5812
Conscientiousness	0.9656	0.3288	7328	−0.0833	<0.0002	7188	−0.3092	<0.0002	6007	0.0877	<0.0002	5809

	Alcohol Use Initiation			Alcohol Consumption			Alcohol Problems			Alcohol Addiction Resistance		
Neuroticism	1.0163	0.72	7326	0.0114	0.5574	7186	0.1778	<0.0002	6007	-0.068	<0.0002	5810
Openness	1.1353	<0.0002	7324	0.0794	<0.0002	7184	0.0356	0.2438	6008	0.0028	0.8430	5811
Personal Devotion	0.6569	<0.0002	7215	-0.272	<0.0002	7086	-0.1189	<0.0002	5932	-0.0231	0.0400	5750
Anxiety Symptoms	1.0743	0.0697	5844	0.0461	0.0227	5729	0.4093	<0.0002	4855	-0.1427	<0.0002	4717
Depressive Symptoms	1.157	0.0002	5843	0.0753	0.0002	5728	0.3798	<0.0002	4852	-0.1375	<0.0002	4714
Environmental Factors												
Deviant Peers in High School	3.2195	<0.0002	7278	0.7739	<0.0002	7148	0.9475	<0.0002	5976	-0.1601	<0.0002	5788
Social Support	1.1134	0.003	5728	0.1222	<0.0002	5620	-0.1005	0.0014	4769	0.0745	<0.0002	4635
Prior Exposure to Natural Disaster	1.0127	0.7543	7079	-0.0254	0.1883	6950	0.0019	0.9693	5819	-0.0143	0.1987	5638
Alcohol-Related Factors												
SRE score	n/a	n/a	n/a	0.3934	<0.0002	3045	0.5055	<0.0002	3116	-0.045	0.0049	3026
AE: Sociability	1.7332	<0.0002	5767	0.4736	<0.0002	5646	0.3402	<0.0002	4820	-0.0249	0.0528	4677
AE: Tension Reduction	1.9896	<0.0002	5801	0.3725	<0.0002	5679	0.1124	0.0005	4837	0.0325	0.0067	4693
AE: Liquid Courage	1.3712	<0.0002	5795	0.3777	<0.0002	5674	0.4873	<0.0002	4834	-0.083	<0.0002	4690
AE: Sexuality	1.622	<0.0002	5351	0.3906	<0.0002	5241	0.4416	<0.0002	4474	-0.0656	<0.0002	4343
AE: Cognitive/Behavioral Impairment	0.5626	<0.0002	5828	-0.2276	<0.0002	5707	-0.0645	0.0486	4854	-0.0214	0.0734	4712
AE: Self-Perception	0.3444	<0.0002	5818	-0.5069	<0.0002	5697	-0.0143	0.6885	4845	-0.0785	<0.0002	4702
DM: Sociality	n/a	n/a	n/a	0.6315	<0.0002	4252	0.6184	<0.0002	4372	-0.0558	<0.0002	4233
DM: Coping	n/a	n/a	n/a	0.2183	<0.0002	4226	0.5943	<0.0002	4343	-0.1596	<0.0002	4206
DM: Enhancement	n/a	n/a	n/a	0.683	<0.0002	4241	0.6629	<0.0002	4361	-0.053	<0.0002	4223
DM: Conformity	n/a	n/a	n/a	-0.0417	0.0575	4248	0.2318	<0.0002	4366	-0.0985	<0.0002	4230

SRE=Self-Rating of the Effects of Alcohol score; AE=alcohol expectations; DM=drinking motives

[1] P-values have been adjusted for multiple testing using the Benjamini-Hochberg procedure

[2] Reference categories are provided in the Methods section.

Table 4

Multivariate model results. Where possible, predictors were standardized (as described in Methods).

Predictor	Alcohol Use Initiation (N=4788)		Alcohol Consumption (N=2548)		Alcohol Problems (N=2604)		Alcohol Addiction Resistance (N=2547)	
	OR	P	Beta	P	Beta	P	Beta	P
Demographics[1]								
American Indian	1.0384	0.5415	−0.0478	0.0163	0.0297	0.4081	**−0.0348**	**0.0183**
Asian	0.8657	0.0055	−0.0553	0.0362	−0.1228	0.0128	0.0278	0.1549
African American	0.8847	0.0321	−0.0365	0.1269	−0.0126	0.7786	−0.0165	0.3527
Hispanic	0.9726	0.6089	−0.0587	0.0021	−0.0571	0.111	−0.0112	0.4279
Multiethnic	0.9983	0.9746	−0.0417	0.0222	−0.0221	0.5195	−0.0109	0.4203
Pacific Islander	0.951	0.3591	−0.0106	0.5294	0.0119	0.7101	−0.0129	0.3046
Unknown Race/Ethnicity	1.0312	0.5347	−0.0276	0.1827	0.0375	0.3412	−0.0275	0.0746
Height	1.0634	0.423	0.0512	0.0737	0.0462	0.3888	0.0141	0.506
Weight	1.065	0.2595	−0.056	0.0165	−0.0869	0.0481	0.0138	0.4273
Parental Education	1.0664	0.2009	0.0047	0.82	0.0557	0.1512	−0.0136	0.3759
Off-Campus Housing	1.0355	0.5022	−0.0092	0.6004	0.0368	0.2631	−0.0154	0.2399
Currently Live with Parents	0.8907	0.0049	−0.0906	<0.0001	−0.1249	0.0019	0.021	0.1858
2-Parent Household During Preschool	1.0498	0.4299	0.0159	0.4642	0.0621	0.1264	−0.0071	0.6595
2-Parent Household	0.8986	0.1374	0.0032	0.8908	−0.0545	0.2133	0.0208	0.2297
During Elementary School								
2-Parent Household During High School	0.9488	0.4326	0.0179	0.4157	0.035	0.3938	−0.01	0.5401
Family History								
Alcohol Problems	**1.283**	**0.0003**	0.0218	0.3409	**0.1031**	**0.0167**	−0.0288	0.0907
Drug Problems	1.0942	0.193	−0.0543	0.0114	0.0185	0.6453	−0.0304	0.0564
Depression	0.8829	0.0372	0.0377	0.1086	0.0781	0.0763	−0.0228	0.1903
Personality & Behavior								
High School Antisocial Behavior	**1.5085**	**<0.0001**	**0.0886**	**<0.0001**	**0.33**	**<0.0001**	**−0.073**	**<0.0001**
Extraversion	**1.2529**	**<0.0001**	**0.1257**	**<0.0001**	**0.1805**	**<0.0001**	−0.007	0.6472

Predictor	Alcohol Use Initiation (N=4788)		Alcohol Consumption (N=2548)		Alcohol Problems (N=2604)		Alcohol Addiction Resistance (N=2547)	
	OR	P	Beta	P	Beta	P	Beta	P
Agreeableness	0.9624	0.487	-0.0038	0.846	-0.0036	0.9214	-0.0082	0.5699
Conscientiousness	1.0304	0.5885	-0.0249	0.224	*-0.123*	*0.0014*	*0.0375*	*0.0138*
Neuroticism	1.0559	0.3823	0.0177	0.4321	-0.0017	0.9677	0.0099	0.5526
Openness	0.9554	0.3659	*-0.0479*	*0.0154*	-0.0084	0.8209	-0.0165	0.261
Personal Devotion	*0.8788*	*0.0149*	*-0.0602*	*0.0028*	0.0265	0.4825	**-0.0333**	**0.0263**
Anxiety Symptoms	0.9464	0.438	0.0074	0.773	**0.2138**	**<0.0001**	**-0.0717**	**0.0002**
Depressive Symptoms	1.1497	0.0727	-0.0402	0.1596	-0.0566	0.2906	-0.0064	0.7637
Environmental Factors								
Perceived Peer Deviance	**1.9386**	**<0.0001**	**0.295**	**<0.0001**	**0.5345**	**<0.0001**	**-0.0926**	**<0.0001**
Social Support	1.0726	0.1709	0.0294	0.1439	*-0.0908*	*0.0163*	*0.0444*	*0.003*
Prior Exposure to Natural Disaster	0.9848	0.7573	-0.0151	0.4116	0.0057	0.8687	-0.0132	0.335
Alcohol-Related Factors								
SRE score	n/a	n/a	**0.2746**	**<0.0001**	**0.3328**	**<0.0001**	-0.0284	0.0759
AE: Sociability	**1.2874**	**<0.0001**	0.043	0.1242	0.0133	0.7996	-0.007	0.7356
AE: Tension Reduction	**1.3688**	**<0.0001**	0.0096	0.6434	*-0.1247*	*0.0014*	*0.0649*	*<0.0001*
AE: Liquid Courage	0.9365	0.2352	**0.0788**	**0.0004**	**0.1601**	**0.0001**	**-0.04**	**0.0152**
AE: Sexuality	**1.2165**	**0.0008**	**0.0683**	**0.0006**	0.0632	0.0919	0.0112	0.4504
AE: Cognitive/Behavioral Impairment	*0.7992*	*0.0002*	*-0.0582*	*0.0038*	*-0.0858*	*0.0227*	-0.0059	0.6907
AE: Self-Perception	*0.4547*	*<0.0001*	0.0053	0.8202	**0.2101**	**<0.0001**	**-0.063**	**0.0003**
DM: Sociality	n/a	n/a	**0.1902**	**<0.0001**	0.0938	0.0664	0.0184	0.3604
DM: Coping	n/a	n/a	-0.0357	0.0858	*-0.1247*	*<0.0001*	*-0.1024*	*<0.0001*
DM: Enhancement	n/a	n/a	**0.2452**	**<0.0001**	**0.1653**	**0.0027**	0.0218	0.3171
DM: Conformity	n/a	n/a	-0.0174	0.3933	0.0634	0.0973	-0.0278	0.067

Italicized text indicates a significant (p<0.05) protective effect; bold text indicates a significant risk factor. Note that higher alcohol addiction resistance scores are a positive outcome, so direction of effect for risk/protective factors differs from other outcomes.

SRE=Self-Rating of the Effects of Alcohol score; AE=alcohol expectations; DM=drinking motives

Table 5

Direction of effects for predictors with standardized effect sizes >0.1. Arrows pointing up indicate riskier outcomes, while arrows pointed down indicate less risky outcomes.

Predictor[1]	Alcohol Use Initiation	Alcohol Consumption	Alcohol Problems	Alcohol Addiction Resistance
Asian			↓	
Currently Live with Parents			↓	
Family History of Alcohol Problems			↑	
High School Antisocial Behavior			↑	
Extraversion		↑	↑	
Conscientiousness			↓	
Anxiety Symptoms			↑	
Deviant Peers in High School	↑	↑	↑	
SRE score		↑	↑	
AE: Tension Reduction			↓	
AE: Liquid Courage			↑	
AE: Self-Perception	↓		↑	
DM: Sociality		↑		
DM: Coping			↑	↑
DM: Enhancement		↑	↑	

[1] Predictors with standardized effect sizes >0.1. Categorical predictors' odds ratios, reported in Table 4, were converted to Cohen's *d* effect sizes.

SRE=Self-Rating of the Effects of Alcohol score; AE=alcohol expectation; DM=drinking motive