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Age of First Use and Delay to First Intoxication in Relation to Trajectories of Heavy Drinking and Alcohol-Related Problems During Emerging Adulthood

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Abstract

Background—Using alcohol at an early age is a well-documented risk factor for heavy drinking and the experience of a range of negative social and health consequences. However, it remains unclear if early consumption of any alcohol or early drinking to intoxication confers the greatest risk.

Methods—Age of onset (AO) and delay to first intoxication (delay) were examined as independent predictors of heavy drinking and the experience of alcohol-related problems (problems) in a sample of incoming college freshmen ($n = 1,160$) who completed biannual assessments from the summer following senior year of high school through senior year of college. The sample included more women (66%) than men and a majority were Caucasian (59%). We employed latent growth curve modeling to examine self-reported AO and delay to self-defined first intoxication as predictors of the frequency of heavy drinking and problems during year 4 of college, as well as changes in these alcohol-related outcomes from high school through college.

Results—An earlier AO and/or a shorter delay was associated with increased frequency of heavy drinking and problems during senior year of college. Although individuals with a later AO and/or a longer delay were at lower risk overall, they showed larger increases in heavy drinking and problems over time.

Conclusions—The findings highlight the importance of distinguishing between AO and delay to first intoxication. Delay accounted for unique variance in drinking outcomes relative to AO, and the effects of AO were stronger when delay was included as a predictor variable. Results are discussed with regard to potential mechanisms through which an early age of intoxication may confer unique risk relative to AO. The implications for cross-cultural differences in risk for problems attributable to early drinking are also discussed.

Keywords

Age of Onset; Emerging Adulthood; Adolescent Alcohol Use; First Intoxication; Alcohol-Related Problems

OVER 400 MILLION PEOPLE worldwide experience problems associated with the use of alcohol (Saraceno and Monteiro, 2001), and an early age of onset (AO) is among the many documented risk factors for experiencing alcohol-related problems (problems). Nationally and internationally representative cross-sectional surveys (e.g., DeWit et al., 2000; Kraus et al., 2000; Livingston et al., 2008), prospective studies (e.g., Warner et al., 2007), and twin studies (e.g., Grant et al., 2006) suggest that an early AO confers risk for numerous problems (e.g., legal problems and alcohol use disorders [AUDs]; Hingson et al., 2006, 2009). Furthermore, this risk persists after accounting for other correlates of hazardous drinking (e.g., polysubstance use and family history of alcoholism; Hingson et al., 2009; Warner and White, 2003). As such, researchers and policy makers have supported policies to postpone AO, including raising the legal drinking age in the United States to 21 years.

However, several studies have failed to find an association between AO and problems, or have identified more complex relations (Afitska et al., 2008; Chou and Pickering, 1992; DeWit et al., 2000). An expanding body of literature, primarily European in origin, has even suggested that under certain circumstances, an early AO may serve a protective function (e.g., Afitska et al., 2008). Even in the United States, the relationship between an early AO and problems is not always linear; Chou and Pickering (1992) demonstrated that individuals who began drinking before age 12 years were at less risk for problems than those who began drinking at ages 12 to 17 years. Similar results have been reported for AUDs (DeWit et al., 2000; Grant et al., 2001).

These complex and sometimes contradictory findings have spurred efforts to identify factors contributing to the differential effects of an early AO across studies. One important issue is the variability across questions used to assess AO. Questions like “how old were you when you first had a drink?” are associated with an earlier AO than questions assessing the onset of regular drinking (e.g., “how old were you when you started drinking once per month?”; Chou and Pickering, 1992). Such discrepancies may translate into meaningful differences in research findings. As such, some recent studies have explicitly defined AO as drinking outside of family or religious contexts and/or consuming more than just a few sips.

Initial drinking experiences resulting in intoxication may be particularly important in predicting alcohol outcomes. Warner and White (2003) found that feeling intoxicated during the first alcohol experience was the strongest prospective predictor of clinically significant drinking, even after accounting for AO, context, and 14 additional psychosocial factors (e.g., family history); >50% of individuals reporting initial intoxication were drinking at levels indicative of AUDs compared to 16% who reported no intoxication. Feeling intoxicated during the first drinking episode also confers risk for problems (intoxication [OR = 2.24], per year versus family history [OR = 2.24], and an early AO [OR = 1.14 per year]) (Warner et al., 2007). Thus, part of the risk for heavy drinking and problems associated with an early AO appears to be linked to an early experience of subjective intoxication.

As such, some researchers have explicitly assessed age of first intoxication (AI). A recent prospective study (Henry et al., 2011) conducted in a sample of 263 urban American Indian youth found that individuals with an AI before age 14 years were more likely than those with a later AI to drink heavily and experience problems at ages 16 to 18 years and to

develop an AUD by age 19 years (40% vs. 17%). Similar results emerged in a sample of nearly 10,000 college students (Hingson et al., 2006). Relative to those with an AI after age 19 years, individuals with an AI before 13 years were more than 3 times as likely to have developed alcohol dependence. Similar relationships have been found among an early AI, binge drinking, drunk driving, injuries, and unprotected sex (Hingson et al., 2003a,b).

Particularly relevant to our study, Monshouwer and colleagues (2003) examined the progression from AO to AI in a sample of Dutch high school students (average delay = 1.65 years) and found that a later AO was associated with decreased probability of drinking to intoxication (a factor of 0.81 per year). Although problems were not assessed, an early AO and AI were associated with deviant behaviors (cigarette/marijuana use). The only additional AI study of which we are aware found no relationship between AI and binge drinking (Afitska et al., 2008).

Although research suggests that AO and AI independently confer risk for problems, AI has never been examined in the context of AO, leaving questions about the unique predictive utility of each. Unfortunately, considering AO and AI simultaneously proves difficult because they are inextricably linked: early intoxication requires early drinking. However, an early AO does not guarantee an early AI; AI can be delayed irrespective of AO. As such, delay from AO to AI (delay) can be examined as a variable that is distinct from AO, permitting an evaluation of the extent to which risk is associated with early drinking versus a quick progression to drinking to intoxication.

The current study examined AO and delay as independent predictors of heavy drinking and problems. Using latent growth curve models, we examined AO and delay as predictors of heavy drinking and problems during senior year of college, as well as changes in these outcomes from senior year of high school through senior year of college. Given the well-established effects of gender, family history, ethnicity, and trait impulsivity on alcohol outcomes including AO, these variables were included as covariates in all models. We hypothesized that an earlier AO and a shorter delay would predict heavy drinking and problems during senior year of college. Given the lack of longitudinal studies examining AO and delay, the analyses predicting changes in drinking and problems throughout college were exploratory. As students enter college, it is possible that an early AO/shorter delay may increase risk for a rapid escalation of drinking. However, consistent with research on younger adolescents (ages 14 to 18 years; Henry et al., 2011), students with an earlier AO/shorter delay are likely to be heavier drinkers before entering college, allowing less room for increases in drinking relative to nondrinkers or lighter drinkers.

Materials and Methods

Participants

The entire incoming freshman class at a southwest university ($N = 6,391$) was recruited during summer orientation activities to participate in a study of risk behavior during the transition from high school through college. Participants ($N = 4,832$) were randomized to 3 conditions. Of the 3,046 randomized to the longitudinal condition upon which the current study focused, 2,245 (73.5%) participants who were unmarried and had never been enrolled

in a 4-year university completed Assessment 1. Participation rates for the remaining assessments ranged from 96% ($N = 2,150$; Year 1) to 63% ($N = 1,539$; Year 4). Our focus on AO and delay required that participants have valid AO/AI data, resulting in the exclusion of 1,060 participants (743 did not complete the eighth assessment when AO/AI was assessed; 309 had not drunk to intoxication by the final assessment; 8 were missing AO data or reported an $AI > AO$). Furthermore, only groups with sufficient sample sizes for meaningful analyses were included (Caucasian, Asian American, African–American, Latino, and multiethnic); 25 participants who were missing racial data or were from a group with insufficient representation were excluded. Ultimately, data from 1,160 participants were used in the current analyses. The sample comprised 66% female participants, 58.7% Caucasians, 16.5% Asian–Americans, 14.7% Latinos, 7.1% multi-ethnics, and 3.0% African–Americans. The average AO was 16.16 years (2.14 SD) with an average delay of 1.25 years (1.95 SD; see Fig. 1 for a plot of AO by delay), and 22% of participants reported a parental history of alcohol-related problems.

Procedure

Participants completed 8 secure, online surveys: 1 during summer after senior year of high school, 6 biannually (college years 1 to 3), and 1 during fall of senior year of college.

Measures

Demographics—Age, gender, and race/ethnicity were assessed.

Family History of Alcohol-Related Problems—The Family Tree Questionnaire (Mann et al., 1985) assessed parental history of problems. Family history-positive participants reported having at least 1 parent who was a probable or definite problem drinker.

Impulsivity—The 8-item impulsivity subscale of the Zuckerman–Kuhlman Personality Questionnaire (Zuckerman et al., 1993) assessed impulsivity at the high school assessment (Cronbach's $\alpha = 0.73$).

AO and AI—AO and AI were assessed during the final assessment. The following question assessed AO: “Not including drinking as part of religious ceremonies, at what age did you take your first drink on your own rather than just a sip from an adult's glass?” For AI, participants indicated the age at which they “first got drunk after drinking alcohol.” Response options included 9, 10 to 12, 13 to 15, 16, 17, 18, 19, and 20 years of age. To facilitate interpretation, values were recoded to 9, 11, 14, 16, 17, 18, 19, and 20 years of age. Correlations between the original and recoded measures were 0.97 and 0.98. Delay was calculated by subtracting AO from AI.

The veracity of self-reported AO/AI was evaluated for participants who initiated alcohol use and/or heavy drinking during the course of the study. An empirical AO and AI were derived for each participant by noting his/her age at the assessment point during which he/she first reported alcohol use or intoxication, respectively. Of the 424 participants who reported an AO of 18 years or older, 363 (85.61%) reported a consistent AO. Most errors of estimation

were underestimates (10.1% reporting an earlier AO than indicated by self-reports of drinking). Among the 665 participants who reported an AI at age 18 years or older, 68.72% of participants reported consistent AIs. As with AO, most errors were underestimates; 23.15% reported an AI that occurred earlier than was indicated by self-report. In summary, retrospective reports of AO and AI were relatively consistent with self-reported drinking.

Frequency of Heavy Drinking and Intoxication—As objective indicators of heavy drinking, participants reported the frequency with which they binge drank (5 drinks for men/4 drinks for women on a single occasion) and drank to intoxication (“got drunk”) over the past 3 months. Correlations between bingeing and intoxication at each time point ranged from 0.76 to 0.82. Thus, the mean of the 2 items at each time point was used as a heavy drinking composite.

Alcohol-Related Problems—The Rutgers Alcohol Problem Index (RAPI; White and Labouvie, 1989) assessed 23 problems commonly reported by young adults (e.g., work/school impairment, blackouts, and vomiting). Internal consistency reliabilities were good across all time points (Cronbach's $\alpha = 0.88$ to 0.92).

Analytic Plan—We evaluated the potential impact of participant attrition on the results of the primary analyses. The sample included in the analyses ($N = 1,160$) was compared to the drinkers who dropped out of the study prior to the final assessment ($N = 868$) on key variables assessed during senior year of high school (age, gender, ethnicity, family history, impulsivity, heavy drinking, and problems). AO and AI were collected at the final assessment, by which point maximum attrition had occurred; therefore, analyses examining differences in these variables across samples were not possible.

Separate linear latent growth curve models were then used to examine changes in heavy drinking and problems from high school through college. Models included latent intercept and slope variables for either frequency of heavy drinking or problems. Weights from the latent intercept variables to each of the 8 indicators (heavy drinking/problems assessed over 8 equally spaced time points) were constrained to 1. Weights from the latent slope variables to the indicators were given equally spaced values ranging from -7 to 0 . To model linear increases in heavy drinking and problems over time, we set the intercept to the final time point. Had we set the intercept to time 1, AO would have predicted prior drinking for all participants who initiated use after the initial assessment. An additional advantage of setting the intercept to the final time point was that analyses in which AO and delay predicted intercepts represented a truly prospective test of the effects of AO and delay on later drinking. The disturbances for the latent intercept and slope were allowed to freely covary. For adjacent time points, the error terms of the observed variables for heavy drinking/problems were allowed to freely correlate (e.g., the wave 4 error term covaried with the wave 3 and wave 5 error terms).

Models examining the impact of AO, delay, and the covariates on the intercepts and slopes for heavy drinking and problems were structured similarly. Covariates (gender, ethnicity [4 dummy codes contrasting ethnic minority groups to Caucasians], impulsivity, and family history) were treated as exogenous predictors of AO, delay, and the intercepts and slopes for

heavy drinking or problems. A directional path was included from AO to delay, permitting an examination of indirect effects of AO on drinking outcomes, operating through delay. Directional paths from AO and delay to the intercepts and slopes for heavy drinking and problems assessed direct effects of each. Finally, the AO by delay interaction was added to each model as a predictor of intercepts and slopes. Model-fit was evaluated using root mean square error of approximation (RMSEA) <0.08 (Browne and Cudek, 1993; MacCallum et al., 1996), comparative fit (CFI), and Tucker-Lewis (TLI) indices >0.90 (Bentler, 1990).

Results

Attrition Analyses

Given the criteria for inclusion in the current analyses, all participants completed at least the first and final assessments. However, of the 2,245 participants who completed assessment 1, nearly 32% dropped out of the study by the final assessment. To evaluate the potential impact of attrition on the results of the primary analyses, we used chi-square analyses and independent sample *t*-tests to compare baseline values on study variables between study completers (*N* = 1,160) and the sample of drinkers who dropped out of the study before the final assessment (*N* = 868). Chi-square tests indicated that those included in the analyses were more likely to be female participants (66.0% vs. 53.8%), $\chi^2(1 \text{ df}) = 31.17, p < 0.001$, and Caucasians (58.7% vs. 51.8%), $\chi^2(7 \text{ df}) = 61.03, p < 0.001$, relative to those who were not included. Included participants were also less impulsive than those who dropped out, $t(df = 1,944) = -2.67, p = 0.008$. No differences were observed for age, frequency of heavy drinking, or problems during senior year of high school. Suggesting that our participants' drinking behavior was representative of typical college drinking, monthly binge drinking rates in the current study (mean 38.8%; range 20.9% during senior year of high school to 46.5% during senior year of college) were consistent with national statistics indicating that approximately 40% of college students binge drink at least monthly (e.g., Grucza et al., 2009; Wechsler et al., 2000).

Missing Data

By senior year of high school, 86.2% of participants had initiated drinking and 68.4% had been intoxicated, with the percentage of those reporting AO and AI increasing over time. Participants were not asked questions about heavy drinking or problems until they reported an AO; therefore, they had “missing” data for these variables until drinking commenced. Although these “missing” data could have been handled with missing data procedures, the “missing” values may have been assigned nonzero values, implying that the participants were drinking when they were not. Rather than excluding the 160 participants who had yet to start drinking by senior year of high school, we set the values for their “missing” drinking data to 0. See Table 1 for the semiannual distributions of the percentage of participants reporting AO/AI, the mean frequencies of heavy drinking/and problems, and the percentage of participants reporting heavy drinking/problems at rates above the mean.

Model for Heavy Drinking

The model evidenced good fit, $\chi^2(df = 72) = 332.94, p < 0.001$; CFI = 0.97; TLI = 0.93; RMSEA = 0.06. Men ($p = 0.02$), Caucasians (p -values < 0.01), and individuals with an

earlier AO ($p < 0.001$) and/or a shorter delay ($p < 0.001$) reported more frequent heavy drinking during senior year of college than their respective counterparts. Regarding changes in drinking over time, male gender ($p = 0.01$), a later AO ($p < 0.001$), and a longer delay ($p < 0.001$) were associated with steeper increases in the frequency of heavy drinking. Figure 2 depicts the model including standardized coefficients (significant paths in bold).

Indirect effects of AO operating through delay were also observed for intercepts ($p < 0.001$) and slopes ($p < 0.001$), although these effects were in the opposite direction of the main effects. An earlier AO was associated with a longer delay, which, in turn, was associated with lower levels of heavy drinking by senior year of college but sharper increases in heavy drinking over time. Given the opposite direction of the direct and indirect effects, total effects (net effects) most accurately represent the influence of AO on heavy drinking intercepts. Net effects were statistically significant (p -values < 0.001) but considerably smaller ($\beta = -0.25$ for intercept; $\beta = 0.13$ for slope) than direct effects ($\beta = -0.39$ for intercept; $\beta = 0.23$ for slope).

AO by Delay Interactions for Heavy Drinking

Model fit remained excellent when the AO by delay interaction was added, $\chi^2(df = 78) = 335.09$, $p < 0.001$; CFI = 0.97; TLI = 0.94; RMSEA = 0.05. All main effects of AO and delay remained. The AO by delay interaction was significant for the slope ($\beta = -0.13$, $p = 0.02$) but not the intercept ($\beta = 0.04$, $p = 0.22$). To decompose the interaction, the model was tested separately for participants with an AO by age 16 years (48.6% of the sample) and an AO after the age of 16 years. Within the earlier AO sample, a longer delay was associated with larger increases in heavy drinking over time ($\beta = 0.28$, $p < 0.001$). In contrast, within the later AO sample, delay was unrelated to changes in heavy drinking ($\beta = 0.01$, $p = 0.92$).

Evidence for a Mediation Model for Heavy Drinking

Suggestive of possible indirect effects, impulsivity and family history were both significant predictors of AO ($p < 0.001$; $p = 0.004$), and AO significantly predicted the intercept. Furthermore, Sobel tests indicated that the indirect effects of family history ($z = 3.86$, $p < 0.001$) and impulsivity ($z = 2.86$, $p < 0.01$) on the intercept for heavy drinking were statistically significant. Thus, a positive family history and high levels of impulsivity contributed to heavier drinking, in part, through an earlier AO.

Model for Alcohol-Related Problems

The model demonstrated excellent fit, $\chi^2(df = 72) = 190.01$, $p < 0.001$; CFI = 0.98; TLI = 0.95; RMSEA = 0.04. An earlier AO ($p < 0.001$), shorter delay ($p < 0.001$), positive family history ($p = 0.02$), and higher impulsivity (trend $p = 0.06$) were associated with more problems during senior year of college. Consistent with the heavy drinking model, male gender ($p = 0.01$), a later AO ($p < 0.001$), and/or a longer delay ($p < 0.001$) was associated with steeper increases in problems over time. Figure 2 depicts the model with standardized regression coefficients (significant paths in bold). Also mirroring the heavy drinking model, the indirect effects of AO operating through delay were in the opposite direction of the main effects for the intercept ($\beta = 0.09$, $p < 0.001$) and slope ($\beta = -0.10$, $p < 0.001$). The net effects of AO were significant ($\beta = -0.14$ for intercept; $\beta = 0.22$, $p < 0.001$ for slope), but

considerably smaller than the direct effects ($\beta = -0.23$ for intercept; $\beta = 0.32$ for slope; Fig. 3).

AO by Delay Interactions for Problems

Similar to heavy drinking, an AO by delay interaction emerged for the slope ($\beta = -0.11$, $p = 0.03$) but not for the intercept ($\beta = 0.05$, $p = 0.19$). Again, a longer delay was associated with larger increases in problems for the earlier AO sample ($\beta = 0.22$, $p < 0.001$) but not the later AO sample ($\beta = 0.08$, $p = 0.18$).

Discussion

Extending previous research on the independent risks associated with an early AO and an early AI, the current study found that when considered simultaneously, an early AO and a quick progression to drinking to intoxication are both important risk factors for heavy drinking and problems during the years spanning senior year of high school through senior year of college. Although the magnitude of the direct effects was larger for AO than delay, this was primarily due to the negative correlation between AO and delay. Accounting for the indirect protective effects of an early AO operating through a longer delay, the net effects of AO and delay on the intercepts of heavy drinking ($\beta = -0.25$ for AO and $\beta = -0.27$ for delay) and problems ($\beta = -0.14$ for AO and $\beta = -0.17$ for delay) were similar.

When considering the added value of assessing AO and delay, these constructs may be particularly informative to neurodevelopmental research documenting the negative effects of alcohol on structural and functional brain development during emerging adulthood. Neuroimaging research has found that binge drinking during adolescence leads to impairments in memory, academic performance, attention, decision making, and reasoning (e.g., Alfonso-Loeches and Guerri, 2011; Crego et al., 2009; Squeglia et al., 2011). The independent effects of AO and delay in the current study are consistent with the notion that adolescent drinking exerts incrementally negative effects on brain development with increasing levels of consumption. Of note, we did not find interactions between AO and delay in the prediction of heavy drinking or problems during senior year of college. This result argues against a “critical period” of vulnerability to the neurotoxic effects of alcohol limited to early adolescence, suggesting instead that vulnerability may persist throughout emerging adulthood. Assessing AO and delay in future neuroimaging studies may help to parse out what negative effects are linked to an early AO versus a quick progression to heavy drinking.

The current study also provided evidence for indirect effects of family history and impulsivity on the frequency of heavy drinking operating through AO. Although these results were based on post hoc analyses and require replication, they suggest that AO may be one mechanism through which trait risk factors influence drinking behavior. Future research may benefit from considering the complex relationship among trait risk factors, AO, and drinking outcomes (e.g., mediation models) rather than simply controlling for trait risk factors.

Also of theoretical importance, the indirect effects of family history and impulsivity operated through AO but not delay. The significant relationship between AO and impulsivity is consistent with arguments that AO may be a marker for underlying vulnerability to drinking (e.g., Prescott and Kendler, 1999). Conversely, delay predicted the alcohol-related outcomes but was not significantly associated with impulsivity or family history, suggesting that delay may represent an “alcohol-specific” risk factor that provides important additional information when assessed alongside AO. These results are also consistent with the notion that early intoxication contributes to future risk, in part, by negatively impacting brain development/function. Presumably, drinking to intoxication negatively impacts brain development universally, making it an unlikely correlate of underlying trait risk factors.

The study results may also be helpful in interpreting cross-cultural differences in the risks for heavy drinking and problems attributed to early drinking. Although the current study suggests that AO and delay are important predictors of drinking outcomes, it also suggests that associations between AO and drinking outcomes may be influenced by underlying trait risk factors, including certain personality traits. Additionally, cross-cultural differences in risk attributed to an early AO may be due, at least in part, to the socioenvironmental context in which drinking occurs. In the United States, drinking at an early age is not socially sanctioned and, as such, may be associated with broader risk for deviant behavior. This may help explain why most research identifying AO as a risk factor for negative alcohol outcomes originates in the United States. In contrast, literature asserting that an early AO confers limited risk or, in some cases, protection against negative alcohol outcomes originates primarily in countries in which earlier drinking is more culturally normative. In these cases, AO may be less likely to be linked to other markers of deviance. However, results may be more consistent for drinking to intoxication at an early age, which is presumably considered negative across cultures. Relatedly, assessing delay could help clarify inconsistent findings about whether “learning to drink” in a family environment increases or decreases risk for negative outcomes (e.g., Foley et al., 2004; McMorris et al., 2011).

Although the context in which drinking begins is important, the context in which use continues is also of interest. College campuses represent a unique setting and there are a number of aspects of college life which may further increase risk for heavy drinking and problems (e.g., fraternity/sorority membership, participation in collegiate athletics, and permissive drinking attitudes; The Century Council, 2011). Future research examining the role of socioenvironmental variables in relations among AO, delay, and alcohol outcomes will be helpful in developing a richer understanding of the factors that contribute to college students' drinking behavior.

Although more exploratory in nature, the analyses examining the effects of AO and delay on changes in drinking and problems across the college years also yielded interesting results. Individuals with an earlier AO and shorter delay remained at higher risk for heavy drinking and problems by senior year of college, but those with a later AO or a longer delay appeared to start to “catch up” over time. Although these results are consistent with a recent study examining the risks associated with an early AI (Henry et al., 2011), they may also reflect a statistical artifact, whereby individuals with an earlier AO or shorter delay had more room

to increase their drinking over time. Consistent with this possibility, a longer delay predicted greater increases in heavy drinking and problems for participants with an earlier AO (by age 16 years) but not for those with a later AO (after age 16 years), more than likely as a result of the restricted range for this variable among those with a later AO. Future longitudinal studies assessing relations between AO, delay, and alcohol outcomes over a longer duration are needed to determine if the current pattern of results persists. If those with a later AO/delay actually do start to “catch up” over time, future research may find that the impact of an early AO on older adults' drinking behavior actually underestimates risk for heavy drinking and problems occurring earlier in development.

Although the current study yielded novel findings, several limitations merit consideration. The study relied on self-report data and was limited by participants' willingness to respond honestly. However, the reliability and validity of alcohol-related self-report measures are well established (e.g., Ahlström et al., 2001; Del Boca and Noll, 2000; Lintonen et al., 2004). Relatedly, there is evidence that self-perception of “drunkenness” is a reliable construct in adolescence (e.g., Lintonen and Rimpelä, 2001), although variability in subjective intoxication may relate differentially to actual consumption levels. Future studies examining AO of an objectively intoxicating amount of alcohol (4 drinks in 2 hours for women; 5 for men) are needed to determine if objectively heavy early drinking is related to later drinking in ways similar to subjective intoxication. Regarding the study sample, the analyses were limited to college students; it remains unclear how the results would generalize across age groups or to comparably aged individuals not enrolled in college. Finally, it is important to note 2 limitations of the assessments of AO and AI. First, reports of AO and AI were retrospective, raising concerns about alcohol-induced memory deficits and/or general bias in recalling prior alcohol-related behavior. However, systematic differences in the reliability of reports of AO and AI based on drinker status seem unlikely, given that the data were collected longitudinally from ages 18 to 22 years, an age range that is considerably closer to AO relative to many previous studies. Second, several response options for AO and AI spanned multiple years (“age 9 or before,” “10 to 12,” “13 to 15”). As such, the delay between AO and AI was likely underestimated or overestimated for some individuals. For example, individuals with an AO of 13 years and AI of 15 years would be assigned a delay value of 0 rather than 2 because AO and AI fell within the answer choice “13 to 15.” Reducing concerns about the measurement limitations, analyses examining onset by delay interactions identified no significant interactions in the prediction of the intercepts for heavy drinking or problems. A shorter delay predicted heavier drinking and more problems by senior year of college, regardless of whether AO was early (by age 16 years) or late (after age 16 years). Furthermore, when the models were limited to the earlier AO sample, AO and delay remained significant predictors of heavy drinking and problems. Taken in concert, these results suggest that the lack of measurement resolution for AO and AI at earlier ages did not impact the overall pattern of results.

Despite the aforementioned limitations, the current study yielded important new findings, identifying a shorter delay to the first experience of subjective intoxication as a novel predictor of heavy drinking and problems, controlling for AO. Given the focus of previous research on AO rather than AI or delay to AI, the vast majority of extant research and public health initiatives advocate for prevention efforts aimed at delaying AO. Despite valiant

efforts, 75% of American high school seniors have used alcohol (Johnston et al., 2006) and over 1 million binge drink at least 6 times monthly (Grunbaum et al., 2002). Furthermore, nearly 40% of college students meet the diagnostic criteria for an AUD (Knight et al., 2002). Although abstinence is the best way to prevent alcohol-related harm, the current study provides evidence for the importance of postponing AI among those who have started drinking. Such efforts may decrease the long-term risk for negative alcohol-related outcomes among those who begin drinking at an early age.

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Fig. 1.
Age of onset by delay to first intoxication.

Fig. 2.
Latent growth model for heavy drinking.

Fig. 3.
Latent growth model for alcohol-related problems.

Drinking Onset, Intoxication Onset, Heavy Drinking, and Alcohol-Related Problems from High School Through Fourth Year of College

Table 1

Time points	1	2	3	4	5	6	7	8
Onset of drinking %	86.2	88.2	90.9	94.5	97.2	99.9	100.0	100.0
Onset of drinking to intoxication %	68.4	72.0	77.0	84.4	92.9	99.7	100.0	100.0
Frequency of heavy drinking Mean (SD)	2.10 (5.09)	3.27 (6.21)	3.74 (6.51)	4.22 (6.65)	3.90 (6.55)	4.38 (7.10)	4.74 (7.06)	4.86 (7.06)
% Engaging in heavy drinking at rates above the mean	22.00	26.98	27.20	29.83	30.00	29.43	31.43	31.82
% Engaging in heavy drinking at least once a month	18.50	27.00	29.00	35.00	42.90	37.10	40.70	42.60
Frequency of experiencing negative consequences of drinking Mean (SD)	2.02 (4.50)	2.95 (5.64)	2.95 (5.07)	3.52 (6.33)	3.00 (5.82)	3.02 (5.64)	3.29 (6.36)	3.25 (5.98)
% Experiencing negative consequences at rates above the mean	23.13	32.50	31.71	28.86	24.81	25.76	26.75	28.08