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Heavy drinking across the transition to college:

Predicting first-semester heavy drinking from precollege variables

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Abstract

Parents, public health officials, college personnel, and society at-large continue to be concerned about the increase in heavy drinking that occurs across the transition to college, prompting alcohol researchers to continue the search for effective interventions. In this report we use data from a large (*N*=3720) prospective study to (1) estimate how predictable heavy drinking in the first semester of college is on the basis of information obtained prior to college and (2) identify precollege variables that are important predictors of heavy drinking in the first semester. We found that first-semester heavy drinking is highly predictable, primarily because of continuity from precollege heavy drinking, but also from precollege peer drinking norms, precollege other substance use (esp. tobacco use), and precollege party motivation for attending college. These findings have implications for both the *timing* and *targets* of interventions. Interventions timed to occur prior to college and/or in the early months of college may disrupt the momentum of previously established drinking behavior. Furthermore, interventions may be most effective if they target conjoint alcohol and tobacco use, college party motivation, and self-selection into heavy-drinking social environments.

Keywords

College students; Prospective study; Heavy drinking; Precollege factors

The high rate of heavy drinking in college (see O'Malley & Johnston, 2002; Wechsler, Lee, Kuo, & Lee, 2000), coupled with the serious consequences that heavy drinking often has for young adults (see Jackson, Sher, & Park, 2005; Perkins, 2002), has sparked deep concerns among parents of college and college-bound students (American Medical Association, 2001), has seized the attention of college administrators (Angelo, 2004), and has prompted public officials to identify heavy drinking by college students as a major public health hazard (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002a). Consequently, identifying risk factors for collegiate drinking, especially those risk factors that are potentially modifiable, represents an important public health effort. A substantial body of resulting research has identified a number of risk factors associated with the heavy-drinking behavior of college students, including person-based factors such as implusive/disinhibited personality traits and alcohol outcome expectancies as well as ostensible environmental factors such as membership in Greek social organizations (see Jackson et al., 2005).

A particularly notable research finding is that, while in high school, college-bound high school seniors drink less heavily than their noncollege-bound peers, but go on to drink more heavily (i.e., more frequent heavy drinking occasions, but not necessarily more frequent drinking overall) than those peer in the years immediately after high school (O'Malley & Johnston,

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2002). Thus, the transition to college is accompanied by a major change in drinking behavior that occurs over a relatively brief time span. Unfortunately, however, the phenomenon of increased drinking during the transition to college has received relatively little attention in the research literature. In fact, we have been able to identify only three prospective studies that focus on the college-transition period, one multi-campus study (Monitoring the Future [MTF]; Johnston, O'Malley, Bachman, & Schulenberg, 2005; McCabe et al., 2005) and two single-campus studies (Baer, Kivlahan, & Marlatt, 1995; Read, Wood, & Capone, 2005). The MTF study, with its multi-stage random sampling of multiple cohorts over a 30-year period, provides a broad overview of longitudinal alcohol-use trends among high school students and young adults in the United States, including those in college; however, the breadth of MTF is achieved at the cost of depth, in that very few correlates of precollegiate drinking are assessed. The other two prospective studies take a more in-depth look at drinking across the college transition by examining a number of potential correlates, although in relatively small, single-institution samples that may not be representative of students at the institutions at which the studies were conducted. For example, Baer et al. (1995) found that male sex, history of conduct problems, and fraternity/sorority residence were risk factors for increased drinking from the senior year in high school to the freshman year of college; however, because of this study's focus on heavy drinkers, the sample in this study consisted entirely of individuals who were heavy drinkers in high school, thus excluding those individuals who showed changes from abstinence or light drinking to heavy drinking. More recently, Read et al. (2005) tested a structural model and observed prospective reciprocal effects between social-influence variables (alcohol offers and peer use/attitudes) and alcohol use across the college transition; however, these findings were based on a convenience sample of less than 25% of the entering students at the study university. Although each of the above three studies sheds light on the issue of heavy drinking across the transition to college, additional studies are needed in which researchers couple a more in-depth, multivariate approach with a more representative sample.

The primary goal of the present report is to characterize those precollege variables that predict heavy drinking during the first semester of college. The predictor variables, drawn from a number of different pertinent domains, are sex, ethnicity, age, precollege substance use, precollege background variables (academic preparation for college, status as a first generation college student, wellness, religion and religiosity, participation in high school sports), precollege college-related motivation, and precollege drinking environment. This study is based on data collected in the first two waves (precollege baseline [wave 0] and first semester of college [wave 1]) of a larger multivariate prospective study of a cohort of entering first-time college (FTC) students at a large Midwestern university. Other reports that focus on a variety of issues of theoretical importance have been and are being generated with data from this larger study (e.g., Grekin & Sher, in press; Grekin, Sher, & Wood, in press; Park, Sher, & Krull, 2006); however, in the present report, we use data from this study to address a simple but critically important public health question: "How well can we predict first-semester college drinking from a brief assessment administered prior to college entry and what precollege variables are the strongest predictors?" Answers to this question can help identify those individuals most at risk for excessive drinking (and thus, potential targets for indicated prevention efforts) as well as variables that imply important etiological processes that prevention programs can target.

In addition, in order to contextualize the current findings and lay the groundwork for more complex and extensive, multivariate analyses, we describe our study sample in some detail with respect to both ascertainment and retention biases and the overall representativeness of the sample.

1. Methods

1.1. Participants

The target population for the precollege sample (wave 0; the summer prior to college) was all first-time college (FTC) students under the age of 21 who went on to be enrolled at a large Midwestern university on the first day of classes in the fall semester of 2002. The sample obtained at wave 0 consisted of 3720 such individuals. These wave 0 participants were 53.6% female and 90.4% non-Hispanic white and had a mean age on the first day of classes of 18.62 years (S.D.=0.36) and a mean ACT (a college-entrance test widely used in the United States) composite score of 25.7 (S.D.=3.44) (see Table 1 for further information). Fall census-date information released by the university registrar confirms that this sample is highly representative of the class of entering FTC students for the fall of 2002. Specifically, the university registrar reported that, on the fall census date, the entering class of FTC students in the fall of 2002 comprised 4226 individuals who were 53.2% female and 89.6% non-Hispanic white and had a mean ACT composite score of 25.8 (University of Missouri-Columbia, 2002).[1] Note that the present sample of 3720 constitutes fully 88% of these 4226 FTC students and that the basic demographic data (i.e., sex, race, and ACT composite) reported by the registrar are virtually identical with that of the present sample.[2]

The first-semester college sample (wave 1; fall semester) consisted of 2615 (70%) of the original 3720 wave 0 participants.[3] This sample was 61.0% female (reflecting greater retention of female participants), 90.4% non-Hispanic white, with a mean age on the first day of classes of 18.60 years (S.D.=0.35). In order to characterize retention bias from wave 0 to wave 1, we compared the wave-0 responses of the 2615 individuals who participated at wave 1 with the wave-0 responses of the 1105 individuals who did not participate at wave 1, using effect size estimates (*d* or *h*, as appropriate; Cohen, 1988). For the vast majority of study variables the absolute value of the effect size was less than .20 (“small” effect). As Table 1 (column at far right) shows, the largest effect size index was observed for sex (*h*=.50; a medium effect size). Other notable effect size indexes were observed for the precollege academic performance variables, the precollege heavy drinking variables, two of the precollege peer drinking norms variables, and precollege community service motivation. A logistic regression in which participation at wave 1 was regressed on sex, high school class rank, precollege past-30-day frequency of 5+ drinks, and precollege interest in community service as a college activity showed that women were more likely to be retained than were men (OR=2.33), as were those who were better prepared academically (OR=1.27), those who engaged in less heavy drinking

[1]The University of Missouri-Columbia, Division of Enrollment Management, Office of the University Registrar reported that the number of FTC students of all ages enrolled at the university on the fall census date (the 20th day of classes) was 4226. Note that this figure includes individuals 21 years old and older who were not part of our sampling frame and also excludes individuals enrolled in the university only between the first day of classes and the fall census who were part of our sampling frame. Although the exact number of individuals in the sampling frame is unknown, we believe that the 4226 figure is a reasonable estimate of the size of the sampling frame.

[2]We also compared characteristics of the 3720 wave 0 participants to characteristics of 679 wave 0 non-participants. These non-participants were FTC students under the age of 21 who did not complete the wave 0 assessment and who were on a list of entering students as of 2 weeks prior to the first day of classes (due to “pre-matriculation dropout,” however, some unknown number of the 679 non-participants never matriculated and were not enrolled on the first day of classes). The results of a series of univariate logistic regressions and a single multivariate logistic regression conducted on the nine variables we had for these 4399 individuals (i.e., 3720 wave 0 participants and 679 wave 0 non-participants) indicated that wave 0 participants were more likely than wave 0 non-participants to be non-Hispanic white and female and to have stronger academic preparation for college. A follow-up logistic regression in which only ethnicity, sex, and academic preparation (class rank percentile) were entered as predictors of wave 0 participation resulted in the following odds ratios (OR): non-Hispanic white (OR=2.77, $p<.001$), female sex (OR=1.32, $p<.01$), class rank percentile (OR=1.50, $p<.001$).

[3]A supplement to wave 1 was conducted at the time of wave 2. In this supplement, selected wave 1 measures were obtained from 239 individuals who did not participate at wave 1. No alcohol variables were obtained in the wave 1 supplement, and therefore, the present study is based on a wave 1 sample of 2615. It is important to note, however, that of the 1105 wave 0 participants who did not contribute data at wave 1, a total of 725 have provided data on one or more subsequent wave. Thus, only 380 (10.2%) of the 3720 wave 0 participants have failed to provide any follow-up data.

and (OR=.88) and, to some degree, those who were interested in community service (OR=1.11).

1.2. Procedure

Participants were recruited during on-campus freshman orientation sessions that took place in the summer prior to their first year of college (wave 0; precollege) and followed up near the end of the first semester (wave 1; first-semester of college). At wave 0, participants completed a 20-min-long paper-and-pencil questionnaire assessing their precollege substance use, other precollege health-related behaviors, and other pertinent precollege variables (e.g., precollege religiosity, precollege academic performance, and precollege college motivation). The questionnaire was completed during a formally scheduled session that took place as part of the summer orientation program. Individuals who did not attend the on-campus orientation program were contacted individually and were given an opportunity to participate by filling out and returning the questionnaire. Each wave 0 participant was re-contacted toward the end of the fall semester and asked to complete a follow-up survey. This wave 1 survey was administered via the internet and was the first of eight planned on-line follow-up surveys scheduled every semester across 4 years. In addition, academic data (e.g., ACT scores) for each participant were obtained from the university registrar. Institutional Review Board approval was obtained prior to both waves of data collection and all participants gave informed consent (assent if under age 18) and parental consent was obtained for all participants under age 18. Participants also gave permission for us to obtain their academic records from the university registrar.

1.3. Variables

Descriptive statistics for all variables are presented in Table 1, along with information regarding the potential range of values associated with each variable. Note that, prior to developing the present prediction models we combined variables into composites whenever appropriate in order to strengthen measurement via the use of multiple indicators of study variables and to reduce multicollinearity among covariates. For each composite, we calculated the mean of the component variables; in cases where the component variables did not share a uniform metric, we first standardized them. If, for a given participant, data were missing for more than a predetermined percent of the component variables (generally 25% to 33%), the composite was considered missing. Coefficient alpha was calculated for each composite (see Table 1).

1.3.1. Precollege heavy drinking—Precollege heavy drinking (α=.95) was assessed as a mean composite of: precollege past-30-day frequency of getting high/light-headed, precollege past-30-day frequency of getting drunk, and precollege past-30-day frequency of drinking 5 or more drinks at a sitting. Our rationale for combining both objective (i.e., 5 or more drinks) and subjective (i.e., feeling light-headed or drunk) measures is to improve reliability over the single-item approaches usually employed and to combine the advantages of objective (i.e., explicit physical referent) and subjective (i.e., “effective” dosing) approaches.

1.3.2. Precollege substance use—The precollege substance use variables in the present study were precollege cigarette use and precollege illicit drug use. We assessed precollege cigarette use with a single item that asked participants how often they had used cigarettes in the past 12 months. Precollege illicit drug use was assessed with a composite which consisted of the mean of seven items assessing the frequency with which the following drugs were used: marijuana/hashish, ecstasy, amphetamines, crack/other forms of cocaine, LSD/psychedelics/hallucinogens, barbiturates/tranquilizers, and heroin/other opiates.

1.3.3. Demographic and precollege background variables—The demographic variables were sex, ethnicity (non-Hispanic white versus other), age (calculated from date of

birth as age on the first day of classes in the first semester of college). The precollege background variables were precollege academic performance, first-generation college status (a designation indicating that neither parent had a college degree prior to the participant's 18th birthday), precollege wellness, high school sports/athletics participation, precollege religiosity, and precollege affiliation with the Catholic or other Christian religion. A number of the precollege background variables were assessed as composites. Precollege academic performance was a composite of three variables: high school core GPA, high school class rank percentile, and ACT composite score. Precollege wellness was a composite of three variables: overall health, frequency of healthy meals, and frequency of exercise. Precollege religiosity was a composite of three variables: importance of religion, frequency of religious services attendance, and frequency of praying. High school sports/athletics participation was a composite of interscholastic sports participation and intramural athletics participation (we believe that the low alpha observed for this composite is not surprising since involvement in interscholastic sports or intramural athletics reduces the opportunity for involvement in the other).

1.3.4. Precollege college-related motivation—The precollege college-related motivation variables, all of which were assessed as composites, were college-party motivation, college-edification motivation, college-arts/activism/altruism motivation, college-sports motivation, college-career motivation, and college-date/mate motivation. Precollege college-party motivation was a composite of three variables: importance of fraternities/sororities in college, importance of parties in college, and importance of attending college to have fun. Precollege college-edification motivation was a composite of four variables: importance of attending college to learn, importance of attending college to broaden perspectives, importance of attending college to attain feelings of accomplishment, and importance of attending college to develop interpersonal skills. Precollege college-arts/activism/altruism motivation was a composite of three variables: importance of arts as a college activity, importance of political activism as a college activity, and importance of community service as a college activity. Precollege college-sports motivation was a composite of four variables: plans to engage in intercollegiate sports, plans to engage in intramural sports, importance of athletics as a college activity, and importance of attending sports events as a college activity. Precollege college-career motivation was a composite of two variables: importance of attending college to get a more satisfying job and importance of attending college to increase earning potential. Precollege college-date/mate motivation was a composite of two variables: importance of attending college to meet a boyfriend/girlfriend and importance of attending college to find a spouse.

1.3.5. Precollege drinking environment—The precollege drinking environment variables were precollege ease of obtaining alcohol and precollege peer drinking norms. Precollege peer drinking norms was a composite of six variables: how most friends feel about drinking, how most friends feel about getting drunk, how many close friends drink alcohol, how much (on average) close friends drink, how many close friends get drunk regularly, and how many close friends drink primarily to get drunk.

1.3.6. Criterion variable: first-semester heavy drinking—The criterion variable in the present study was first-semester heavy drinking which was assessed with a composite variable that paralleled the precollege heavy drinking variable (α=.92).

1.3.7. Other variables—Other variables were assessed in the precollege baseline of the larger prospective study, however, we restricted the present study to variables that were relevant to all entering students and were not conditional on substance use. That is, reasons for drinking and reasons for smoking were omitted from the present study because they were

assessed only for drinkers and smokers, respectively; variables related to drinking consequences and dependence symptoms were omitted because we conceptualized them to be consequential to alcohol use (esp. heavy drinking).

2. Results

2.1. Heavy drinking across the transition to college

The data for heavy drinking (getting high/light-headed, getting drunk, having 5+ drinks) at waves 0 and 1 are summarized by sex in Table 2, both as percentages across the various response categories and as overall means of the ordinal scales employed in the surveys. Prior to college, about half the male participants reported having engaged in past-30-day heavy drinking (across all three measures) and, in the first semester of college, close to two-thirds of the male participants reporting having engaged in heavy drinking in the past 30 days. A similar pattern of increase was observed for women, although at a somewhat lower level for getting drunk and having 5 or more drinks at a sitting. To test the significance of the change in heavy drinking observed from precollege to the first semester, we conducted a mixed model analysis SAS PROC MIXED (SAS 9.1) in which participants were treated as a random effect (to allow for the inclusion of participants whose data were missing at wave 1) for each of the three heavy-drinking measuresseparately. These analyses indicated that heavy drinking, as assessed by each of the three measures, increased significantly from precollege to the first semester of college ($p<.001$) and that men engaged in more heavy drinking than women ($p<.001$). There was no significant interaction of sex with wave ($p>.05$), indicating comparable increases for men and women. Although the mean increase in heavy drinking during the college transition was consistent across alternative measures of heavy drinking, it is important to highlight the fact that most of this increase was attributable to nonheavy drinkers becoming heavy drinkers and not to a further increase in the frequency of heavy drinking among those who already were drinking heavily prior to college (see Table 2).

2.2. Prospective models of first-semester heavy drinking

Hierarchical multiple regression was used to model first-semester (wave 1) heavy drinking as a function of precollege (wave 0) heavy drinking and predictors from the following five domains: demographics, precollege cigarette and other drug use, background variables, precollege college-related motivation, and precollege drinking environment. We conducted this analysis in a series of six planned steps in which we began by predicting first-semester heavy drinking solely as a function of precollege heavy drinking and then, in the five subsequent steps, we added variables from the above five predictor domains sequentially (see Table 3 for a summary of each step). In the first step, we found that precollege heavy drinking alone accounted for 46% of the variance in first-semester heavy drinking, which is perhaps our most critical finding in that it demonstrates that heavy drinking in the first semester of college, although higher than at the end of high school, is strongly predicted by precollege heavy drinking. We also found that the addition of the five predictor domains increased the amount of variance accounted for to 54%. Based on the standardized regression coefficients, the most important positive predictors of first-semester heavy drinking, in addition to precollege heavy drinking, were precollege peer-drinking norms, precollege college-party motivation, and precollege cigarette use; the most important negative predictor was precollege religiosity (although the coefficient for religiosity was relatively small in absolute value).

2.3. Cross-sectional models of precollege heavy drinking

Because of the importance of precollege heavy drinking as a predictor of first-semester heavy drinking, we also modeled precollege heavy drinking as a function of other precollege variables. To accomplish this, we conducted two parallel sets of hierarchical multiple regression analyses, one set based on the data of all wave 0 participants (full sample; $n=3720$)

and another set based on the data of participants who were retained in wave 1 (retained sample; *n*=2615). Both sets of analyses were conducted in a series of five steps which are summarized in Table 4 (due to the similarity of the models in both the full-sample and retained-sample sets, Table 4 shows only steps 3 and 5 of the retained-sample set). The picture that emerges from these analyses is that precollege heavy drinking is positively related to several precollege variables, most particularly precollege peer drinking norms, precollege cigarette and other drug use, and precollege party motivation. The fact that the results were similar across the full and attrition-adjusted samples indicates that the associations among variables at the precollege baseline were not noticeably altered when attrition was considered, providing greater confidence that our prospective findings were not unduly affected by attrition effects.

3. Discussion

Parents, college personnel, and society at large are concerned about the escalation of heavy drinking that occurs across the transition to college and persists over the college years; however, because of the dearth of prospective data across the transition, we know very little about the potential influences contributing to this increase. In this paper we use data from our ongoing prospective study of college student drinking to estimate how predictable first-semester heavy drinking is on the basis of information obtained with a brief assessment prior to college matriculation and to identify variables that are important predictors of heavy drinking in the first semester of college. Note that our focus here is on individual differences that can be assessed prior to college entry and not on all relevant variables predicting first-semester college drinking. Clearly, factors such as type of residence, Greek affiliation, and specific peer groups that students encounter once they arrive on campus contribute to first-semester drinking. Additionally, there is considerable heterogeneity in typical drinking rates across campuses (e.g., Presley, Meilman, & Leichliter, 2002; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994) that probably reflects self-selection (e.g., based on the reputation of campuses as being “party schools” or being focused on discipline and academics) that cannot be resolved in a single campus study. Thus, our study findings are conditioned on an abbreviated set of measures that we collected prior to students’ matriculation at a large, primarily residential, state university that is characterized by a strong emphasis on intercollegiate sports and a prominent Greek system (institutional characteristics strongly associated with heavy drinking; Presley et al., 2002; Wechsler et al., 1994). These study characteristics need to be kept in mind when considering our findings and their implications.

3.1. Predictability of first-semester heavy drinking from precollege variables

Despite a substantial mean level increase in heavy drinking across the transition to college, the current study demonstrates exceptionally strong prospective prediction of heavy drinking across this transition, accounting for more than 50% of the variance in first-semester college drinking, largely due to rank-order stability in heavy drinking. This finding is important because it suggests that it is possible to determine which matriculating students are at highest risk for heavy drinking in their first semester of college based on their responses to a brief (20-min-long) precollege survey. The high degree of prospective prediction in the present study is particularly noteworthy given that the precollege variables we assessed are not exhaustive, with some relevant domains not assessed at all (e.g., neuropsychological functioning and physiological variables) and other relevant domains not assessed until after college matriculation (e.g., expectancies, personality, family history). Incorporating other predictors into a precollege assessment could potentially improve the prediction of risk beyond even the high level of prediction observed with our present set of variables, although any increments in prediction are likely to be quite low given that there are few, if any, surveys of collegiate drinking that explain more drinking variation than we have in the current study.

3.2. First-semester heavy drinking: Continuity across the college transition

Regarding the specific predictors of first-semester heavy drinking, the most notable finding is that heavy drinking in first-semester first-time college students is strongly associated with precollege heavy drinking. Thus, collegiate drinking, at least in the first semester, represents a systematic escalation of an ongoing behavior established prior to college as opposed to chaotic, unpredictable change (e.g., a "developmental disturbance;" Schulenberg et al., 2001) precipitated by the transition to college and a host of related transitions inherent in the college transition (e.g., the "leaving home" transition). Thus, although there are many good reasons to focus on "college drinking" as a national health problem (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002b), we need to view early college drinking as embedded in the context of ongoing adolescent development and not view it as a highly discontinuous phenomenon, at least with respect to the majority of students who initiate heavy-drinking behavior prior to college. Even though precollege drinking is, by far, the strongest correlate of first-semester drinking, it is noteworthy that other precollege predictors have the ability to provide statistically unique prediction over and above precollege drinking. Specifically, these other predictors are having heavier drinking peers, smoking cigarettes and using other substances, valuing college partying, having a Catholic or other Christian religious affiliation while being less religious, being male, being more able to obtain alcohol, and being less interested in attending college to gain knowledge. The picture that emerges from these correlates is that future collegiate heavy drinkers are more heavily involved in substance use in general (not just alcohol) during high school, are more involved in a social network that provides both facilitative norms and increased access to alcohol and are less likely to report involvement in religious observances and activities. Importantly, these future collegiate heavy drinkers view partying as an important motive for attending college, suggesting that the college environment itself is looked forward to as a place where drinking and socializing needs can be met. It is noteworthy that party motivation predicts future drinking beyond the prediction afforded by prior drinking, indicating that motives which support drinking exert an influence that is independent of established high school drinking patterns.

The finding that drinking in the first semester was predicted uniquely by precollege peer drinking norms is of particular interest because the college transition represents, for many individuals, a major upheaval in peer group membership. Presumably, the reason why precollege peer norms are propagated across the college transition is because heavier drinking individuals affiliate with heavier drinking peers in college (Bullers, Cooper, & Russell, 2001) and such peer-selection effects occur rather quickly, perhaps surprisingly so, across the social and geographic relocations that occur with the college transition. It would be useful to determine whether peer selection based on nondrinking-related characteristics (e.g., such as shared academic or social interests) can be used to counter, or at least reduce, the strong effects of peer selection based on drinking characteristics. Many universities have instituted residence-hall programs organized around specific themes (e.g., freshmen interest groups) and it would be useful to examine their potential prevention effects on alcohol use.

3.3. Limitations

The current study has several limitations that warrant mention. Most critically, it is being conducted on a single college campus and, consequently, caution should be taken when attempting to generalize to college students overall or to students at other types of campuses that differ with respect to both the composition of the student body and the traditions and policies of the campus. It is important, however, to note that the particular campus at which our project took place is reflective of many types of large, heavy-drinking public universities with substantial fraternity/sorority involvement and high profile intercollegiate athletics (Presley et al., 2002). Also, because our study relies primarily on participants' self reports, the obtained data are subject to a variety of self-report biases. We note, however, that research has

shown that self-reports of drinking tend to be reasonably accurate when there are no clear contingencies associated with under- or over-reporting (see Sher & Epler, 2004). Still, college students tend to overestimate "standard drinks" (White et al., 2005), thereby, underestimating their actual consumption. To partially counter students' tendency to underestimate consumption, we employed a measure of heavy drinking that is a composite of both objective (i.e., 5 or more drinks in a sitting) and subjective (i.e., feeling "high" and feeling drunk) measures of intoxication. In addition to addressing concerns about "standard drinks," the inclusion of subjective measures also addresses individual differences in body weight, pharmacokinetics (i.e., metabolism), pharmacodynamics (i.e., functional effects), and length of drinking episode. Finally, although we had excellent recruitment rates (88% of the sampling frame), we retained only 70% of baseline participants at the first follow-up and attriters tended to be male, less academically prepared, and heavier drinkers prior to college. We do not believe that this attrition overly biased our findings, however, because the parameter estimates in models of heavy drinking based on the sample of all individuals who participated in the precollege assessment were strikingly similar to those in the model of precollege heavy drinking based on the "retained" sample of individuals who participated in both waves 0 and 1.

3.4. Implications

The findings described in the present report have implications for the timing and targets of intervention programs designed to reduce the problem of heavy drinking in college. Regarding the timing of such programs, the present finding that heavy drinking in the first semester of college largely is an extension of the pattern of drinking established prior to college suggests that interventions aimed at problematic college drinking may benefit from implementation prior to college entry or during the early weeks or months following college enrollment. Some support for the efficacy of precollege interventions has been provided by Turrisi, Jaccard, Taki, Dunnam, and Grimes (2001), who demonstrated success with a parent-based intervention implemented in the period between graduation from high school and college entrance; however, additional research is needed to determine the optimal timing of college-drinking interventions. Presumably, effective college-drinking prevention programs will require a range of interventions addressing the developmental and social factors associated with the rapid set of transitions that follow high school graduation for many students (see Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002a).

Regarding the targets of intervention programs, the present findings highlight three potential foci: conjoint alcohol and tobacco use, peer drinking norms, and college-party motivation. First, the unique importance of precollege cigarette use for first-semester heavy drinking underscores the conjoint nature of the drinking-smoking relationship (see also, Jackson, Sher, & Schulenberg, 2005) and suggests that targeting tobacco use, either individually or concurrently with alcohol use, might enhance intervention efforts. The successful simultaneous reduction of alcohol and tobacco use resulting from prevention programs such as the Iowa Strengthening Families Program (Spoth, Redmond, & Shin, 2001) with elementary-school students and the revised ALERT program (Ellickson, McCaffrey, Ghosh-Dastidar, & Longshore, 2003) with middle-school students points to the potential promise of prevention programs that dually target smoking and drinking (see review of prevention programs by Foxcroft, Ireland, Lister-Sharp, & Breen, 2003). Second, the importance of precollege peer drinking norms as a unique predictor of first-semester heavy drinking suggests that individuals who associate with heavy-drinking peers in high school may seek out similar peers in college, a finding consistent with previous research demonstrating that college students self-select into heavy-drinking social environments (e.g., McCabe et al., 2005; Read, Wood, Davidoff, McLacken, & Campbell, 2002). Interventions could target the self-selection effect by focusing on entering students who affiliated with heavy-drinking peers in high school and who intend

to affiliate with heavy-drinking peers in college, for example, by joining a fraternity/sorority, (see McCabe et al., 2005) and by focusing on the social environments into which students self-select by, for example, implementing responsible beverage service policies (e.g., Salz & Stanghetta, 1997) and/or increasing the enforcement of the minimum legal drinking age law (e.g., Wagenaar & Toomey, 2002). As noted earlier, it appears that students rapidly assort on the basis of drinking proclivities soon after they arrive on campus. Inhibition of this selective assortment might represent a helpful strategy for dampening heavy alcohol consumption. The creation of competing structures for assortment, such as Freshman Interest Groups (Tinto & Goodsell, 1993) in which students are clustered in social groups and residence halls based on academic or avocational interests, might dilute alcohol-related selective assortment and disrupt continuity in the peer drinking environment. Third and finally, the importance of the precollege college-party motivation as a unique predictor of first-semester heavy drinking suggests that interventions aimed at reducing heavy drinking in college should be focused, at least in part, on entering students who assert that partying, fun and fraternities/sororities are important college activities. Interventions could attempt to alter college-party motivation through programs designed to change students' alcohol beliefs and expectancies regarding how sociable and attractive they are after consuming large amounts of alcohol via expectancy challenge interventions (e.g., Darkes & Goldman, 1993), or by implementing campus policies/practices that structure the social environment to reduce/eliminate traditional alcohol-centered activities (e.g., keg parties and tailgating parties) in favor of alternative ways to satisfy the desire to party and have fun such as "alcohol-free, expanded late-night student activities" (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002b; Toomey & Wagenaar, 2002).

The present findings also have implications for college administrators who wish to make policy changes to reduce heavy drinking on their campuses by discouraging heavy-drinking individuals from applying (see Angelo, 2004). Given that high school heavy drinkers tend to become college heavy drinkers, colleges wishing to reduce the number of heavy drinking students on their campuses could focus recruitment efforts on abstemious or extremely light-drinking high school students and actively dissuade heavy drinkers by promoting a collegiate environment where alcohol-control policies are highlighted and clear expectations about endorsed drinking norms are explicitly conveyed. In addition, college administrators could take steps to reduce the public perception of their college as being in, any way, a "party school" by such measures as maintaining or reinstating Friday classes, actively suspending or expelling students who are detected drinking, and working with police agencies and local businesses to reduce underage alcohol sales in the surrounding community (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002b).

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Table 1

Descriptive statistics

	Full sample [a] percent or mean (S.D.)	Retained sample [b] percent or mean (S.D.)	Retention effect size [c]
Demographic domain			
Female sex	53.58%	60.96%	*h*=.50
White, non-Hispanic ethnicity	90.36%	90.38%	*h*=.01
Age on the first day of classes	18.62 (0.36)	18.60 (0.35)	*d*=-.13
Precollege substance use domain			
Precollege cigarette use frequency (past year) (0-6 scale)	1.57 (2.29)	1.46 (2.22)	*d*=-.17
Precollege other drug use (past year) composite (α=.84)	0.24 (0.29)	0.21 (0.46)	-
Marijuana/hashish use frequency (0-6 scale)	1.14 (1.89)	1.02 (1.78)	*d*=-.22
Ecstasy/MDMA use frequency (0-6 scale)	0.07 (0.41)	0.07 (0.41)	*d*=-.04
Amphetamine use frequency (0-6 scale)	0.09 (0.54)	0.07 (0.48)	*d*=-.09
Crack/cocaine use frequency (0-6 scale)	0.07 (0.45)	0.06 (0.41)	*d*=-.07
LSD/other hallucinogen use frequency (0-6 scale)	0.07 (0.39)	0.06 (0.36)	*d*=-.08
Barbiturate/tranquilizer use frequency (0-6 scale)	0.17 (0.69)	0.14 (0.60)	*d*=-.15
Heroin/other opiate use frequency (0-6 scale)	0.07 (0.44)	0.06 (0.39)	*d*=-.08
Background variable domain			
Precollege academic performance composite (α=.77)	0.00 (0.83)	0.00 (0.83)	-
HS core GPA (4-point scale)	3.40 (0.48)	3.45 (0.45)	*d*=.38
HS class rank percentile	76.77 (18.65)	78.77 (17.40)	*d*=.37
ACT composite score	25.69 (3.44)	25.94 (3.45)	*d*=.25
First-generation college status	28.66%	29.18%	*h*=.04
Precollege wellness composite (α=.84)	0.00 (0.74)	0.00 (0.73)	-
Health (1-5 scale)	3.95 (0.81)	3.94 (0.80)	*d*=-.04
Healthy eating (0-4 scale)	2.49 (0.85)	2.50 (0.84)	*d*=.05
Exercise (0-8 scale)	4.02 (2.04)	3.97 (2.03)	*d*=-.08
Precollege Catholic religion	33.32%	33.24%	*h*=-.01
Precollege other Christian religion	47.76%	48.36%	*h*=.04
Precollege religiosity composite (α=.90)	0.00 (0.89)	0.00 (0.89)	-
Religion importance (1-4 scale)	2.79 (1.01)	2.81 (1.00)	*d*=.08
Religious service attendance (0-7 scale)	3.27 (1.94)	3.35 (1.94)	*d*=.14
Prayer frequency (0-8 scale)	4.80 (2.62)	4.90 (2.58)	*d*=.13
High school sports/athletics composite (α=.33)	0.00 (0.77)	0.00 (0.78)	-
Interscholastic high school sports	56.08%	56.35%	*h*=.02
Intramural high school athletics	27.39%	26.13%	*h*=-.09
Precollege college-related motivation domain			
Precollege college-party motivation composite (α=.65)	0.00 (0.77)	0.00 (0.77)	-
Fraternity or sorority life (1-4 scale)	2.06 (1.06)	2.03 (1.05)	*d*=-.08
Parties (1-4 scale)	2.47 (0.96)	2.42 (0.96)	*d*=-.17
Have fun (1-4 scale)	3.29 (0.70)	3.27 (0.70)	*d*=-.09
Precollege college-arts/activism/altruism motivation composite (α=.44)	0.00 (0.69)	0.00 (0.68)	-

	Full sample [a] percent or mean (S.D.)	Retained sample [b] percent or mean (S.D.)	Retention effect size [c]
Arts (1-4 scale)	1.91 (0.93)	1.95 (0.93)	*d*=.11
Political activism (1-4 scale)	1.77 (0.84)	1.76 (0.84)	*d*=-.01
Community service (1-4 scale)	2.34 (0.83)	2.40 (0.83)	*d*=.26
Precollege college-sports motivation composite (α=.63)	0.00 (0.69)	0.00 (0.69)	-
Plan intercollegiate sports	11.44%	10.24%	*h*=-.12
Plan intramural athletics	64.69%	63.89%	*h*=-.06
Athletics (1-4 scale)	2.18 (1.01)	2.13 (1.00)	*d*=-.16
Attend sports events (1-4 scale)	2.80 (0.91)	2.78 (0.91)	*d*=-.09
Precollege college-career motivation composite (α=.68)	0.00 (0.87)	0.00 (0.88)	-
More satisfying job (1-4 scale)	3.73 (0.52)	3.73 (0.52)	*d*=.01
Increase earning potential (1-4 scale)	3.56 (0.65)	3.56 (0.65)	*d*=-.03
Precollege college-edification motivation composite (α=.74)	0.00 (0.75)	0.00 (0.75)	-
Broaden perspectives (1-4 scale)	3.33 (0.72)	3.34 (0.71)	*d*=.05
Learn (1-4 scale)	3.65 (0.54)	3.67 (0.53)	*d*=.08
Accomplishment (1-4 scale)	3.14 (0.81)	3.14 (0.80)	*d*=-.02
Interpersonal skills (1-4 scale)	3.11 (0.78)	3.10 (0.77)	*d*=-.02
Precollege college-date/mate motivation composite (α=.81)	0.00 (0.92)	0.00 (0.92)	-
Meet boyfriend/girlfriend (1-4 scale)	1.85 (0.90)	1.81 (0.88)	*d*=-.16
Find spouse (1-4 scale)	1.54 (0.80)	1.52 (0.78)	*d*=-.08
Precollege drinking environment domain			
Precollege ease of obtaining alcohol (1-4 scale)	3.62 (0.76)	3.45 (0.63)	*d*=-.03
Precollege peer drinking norms composite (α=.93)	0.00 (0.86)	0.00 (0.86)	-
Friends' feelings about drinking (1-5 scale)	3.59 (0.97)	3.54 (0.97)	*d*=-.16
Friends' feelings about getting drunk (1-5 scale)	3.37 (1.09)	3.31 (1.10)	*d*=-.18
How many friends drink (0-5 scale)	2.83 (1.54)	2.76 (1.54)	*d*=-.16
How much friends drink (0-4 scale)	2.49 (1.23)	2.40 (1.23)	*d*=-.25
How many friends drink to get drunk (0-5 scale)	2.10 (1.68)	2.02 (1.67)	*d*=-.22
How many friends drunk regularly (0-5 scale)	1.99 (1.65)	1.89 (1.61)	*d*=-.16
Heavy drinking			
Precollege heavy drinking composite[d] (α=.95)	1.18 (1.45)	1.07 (1.67)	-
Precollege frequency of feeling high past 30 days (0-7 scale)	1.31 (1.57)	1.20 (1.49)	*d*=-.21
Precollege frequency of 5+ drinks past 30 days (0-7 scale)	1.12 (1.52)	0.99 (1.42)	*d*=-.24
Precollege frequency of getting drunk past 30 days (0-7 scale)	1.11 (1.45)	1.01 (1.37)	*d*=-.29
First-semester heavy drinking composite (α=.92)		1.36 (1.29)	
First-semester frequency of feeling high past 30 days (0-7 scale)		1.54 (1.41)	n/a
First-semester frequency of 5+ drinks past 30 days (0-7 scale)		1.28 (1.42)	n/a
First-semester frequency of getting drunk past 30 days (0-7 scale)		1.27 (1.32)	n/a

[a] The *n*=3720 individuals who participated at wave 0 comprise the full sample; however, the actual sample sizes for the information presented in this table ranged from *n*=3552 to *n*=3720.

[b] The *n*=2615 individuals who participated in both wave 0 and wave 1 comprise the retained sample; however, the actual sample sizes for the information presented in this table ranged from *n*=2509 to *n*=2615.

[c] The retention effect size consists of Cohen's *d* (means) or *h* (percents) calculated for wave 1 participants (retained sample) versus wave 1 non-participants (non-retained sample) for each of the precollege variables. Positive values indicate that the retained sample had a higher mean or greater percent than the non-retained sample; negative values indicate that the retained sample had a lower mean or lesser percent than the non-retained sample.

[d] The precollege heavy drinking composite was a predictor variable in the model of first-semester heavy drinking but was the criterion variable in the model of precollege heavy drinking.

Table 2

Precollege and first-semester past-30-day heavy drinking: percents and means

	Men			Women		
	Precollege (wave 0)		First semester (wave 1)[a]	Precollege (wave 0)		First semester (wave 1)[a]
	Full sample[b]	Retained sample[c]		Full sample[b]	Retained sample[c]	
Number times high past 30 days						
0 times	47%	49%	35%	49%	50%	36%
1 time	11%	12%	12%	15%	15%	15%
2-3 times	14%	13%	18%	17%	17%	23%
1-2 times per week	14%	14%	26%	12%	11%	20%
3-4 times per week	8%	7%	7%	5%	4%	5%
5+ times per week	5%	4%	2%	2%	2%	1%
Mean (S.D.) (0-7 scale)	1.5 (1.7)	1.3 (1.6)	1.7 (1.5)	1.2 (1.4)	1.1 (1.4)	1.5 (1.4)
Number times drunk past 30 days						
0 times	50%	53%	39%	55%	57%	44%
1 time	12%	12%	14%	16%	16%	19%
2-3 times	14%	14%	20%	15%	13%	18%
1-2 times per week	14%	13%	20%	10%	10%	15%
3-4 times per week	6%	4%	5%	4%	3%	4%
5+times per week	4%	3%	2%	1%	1%	1%
Mean (S.D.) (0-7 scale)	1.3 (1.6)	1.2 (1.5)	1.4 (1.4)	1.0 (1.3)	0.9 (1.3)	1.2 (1.3)
Number times 5+ drinks past 30 days						
0 times	48%	50%	36%	61%	63%	52%
1 time	10%	12%	13%	13%	13%	15%
2-3 times	14%	13%	18%	12%	12%	15%
1-2 times per week	14%	14%	23%	8%	8%	13%
3-4 times per week	8%	6%	8%	4%	3%	4%
5+ times per week	5%	4%	3%	2%	1%	1%
Mean (S.D.) (0-7 scale)	1.4 (1.7)	1.3 (1.6)	1.6 (1.5)	0.9 (1.3)	0.8 (1.3)	1.1 (1.3)

[a] The n=2615 individuals who participated in the first-semester college assessment (wave 1) comprise the first semester sample; however, the actual sample sizes for the information presented in this table ranged from n=2568 (n=1573 women and n=995 men; n=1576 women and n=992 men) to n=2570 (n=1577 women and n=993 men), depending on patterns of missing data.

[b] The *n*=3720 individuals (*n*=1993 women and *n*=1727 men) who participated in the precollege assessment (wave 0) comprise the full sample; however, the actual sample sizes for the information presented in this table ranged from *n*=3714 (*n*=1992 women and *n*=1722 men) to *n*=3706 (*n*=1988 women and *n*=1718 men), depending on patterns of missing data.

[c] The *n*=2615 individuals who participated in both the precollege assessment (wave 0) and the first-semester college assessment (wave 1) comprise the retained sample; however, the actual sample sizes for the information presented in this table ranged from *n*=2608 (*n*=1591 women and *n*=1017 men) to *n*=2613 (*n*=1594 women and *n*=1019 men), depending on patterns of missing data.

Table 3

Prospective models of heavy drinking in the first semester of college: standardized regression coefficients and adjusted R^2 values

	Step 1 *n*=2569	Step 2 *n*=2568	Step 3 *n*=2561	Step 4 *n*=2514	Step 5 *n*=2500	Step 6 *n*=2470
Precollege heavy drinking (Step 1)	.68*	.67*	.57*	.53*	.46*	.39*
Demographic domain (added Step 2)						
Sex (male=1; female=0)		.06*	.07*	.05*	.05**	.05*
Ethnicity (white=1; non-white=0)		.06*	.06*	.05*	.04**	.03***
Age on first day of classes		-.04***	-.03***	-.04**	-.03***	-.04**
Precollege substance use domain (added Step 3)						
Precollege cigarette use frequency (past year)			.17*	.17*	.15*	.13*
Precollege other drug use frequency (past year)			.01	.01	.01	.01
Background variable domain (added Step 4)						
Precollege academic performance				-.03***	-.02	-.02
First-generation college status				-.02	-.01	-.01
Precollege wellness				.02	.02	.02
Precollege Catholic religion (yes=1; no=0)				.08*	.04	.03
Precollege other Christian religion (yes=1; no=0)				-.02	-.01	-.01
Precollege religiosity				-.10*	-.08*	-.06*
High school sports/athletics				.06*	.05**	.03***
Precollege college-related motivation domain (added Step 5)						
Precollege college-party motivation					.19*	.15*
Precollege college-arts/activism/altruism motivation					-.03***	-.02
Precollege college-sports motivation					-.02	-.02
Precollege college-career motivation					.00	.00
Precollege college-edification motivation					-.04**	-.04***
Precollege college-date/mate motivation					.00	.01
Precollege drinking environment domain (added Step 6)						
Precollege peer drinking norms						.17*
Precollege ease of obtaining alcohol						-.04**
Adjusted R^2	.46	.47	.49	.50	.53	.54

*p<.001.

** $p<.01$.

*** $p<.05$.

Table 4

Cross-sectional models of precollege heavy drinking: standardized regression coefficients and adjusted R^2 values

	Full sample					Retained sample	
	Step 1, *n*=3713	**Step 2, *n*=3704**	**Step 3, *n*=3628**	**Step 4, *n*=3605**	**Step 5, *n*=3543**	**Step 3, *n*=2554**	**Step 5, *n*=2470**
Demographic domain (Step 1)							
Sex (male=1; female=0)	.12*	.08*	.06*	.05**	.05*	.06*	.05*
Ethnicity (white=1; non-white=0)	.13*	.08*	.06*	.04**	.02	.06*	.01
Age on first day of classes	.03	.03***	.02	.02	.02	.01	.01
Precollege substance use domain (added Step 2)							
Precollege cigarette use frequency (past year)		.38*	.36*	.30*	.21*	.36*	.21*
Precollege other drug use frequency (past year)		.31*	.30*	.27*	.21*	.28*	.19*
Background variable domain (added Step 3)							
Precollege academic performance			-.06*	-.04**	-.02	-.05*	-.01
First-generation college status			.00	.01	.01	.00	.01
Precollege wellness			.05*	.04**	.02	.05**	.02
Precollege Catholic religion (yes=1; no=0)			.21*	.12*	.08*	.20*	.07**
Precollege other Christian religion (yes=1; no=0)			.12*	.06**	.05**	.13*	.05***
Precollege religiosity			-.14*	-.09*	-.04**	-.13*	-.03
High school sports/athletics			.10*	.05	.02	.10*	.01
Precollege college-related motivation domain (added Step 4)							
Precollege college-party motivation				.28*	.14*		.14*
Precollege college-arts/activism/altruism motivation				-.07*	-.03***		-.03***
Precollege college-sports motivation				.01*	.01		.01
Precollege college-career motivation				.00	.00		.00
Precollege college-edification motivation				-.04*	-.03***		-.03***
Precollege college-date/mate motivation				-.02	.00		.00
Precollege drinking environment domain (added Step 5)							
Precollege peer drinking norms					.39*		.40*
Precollege ease of obtaining alcohol					.04*		.04**
Adjusted R^2	.04	.39	.43	.50	.58	.39	.54

* $p<.001$.

** $p<.01$.

*** $p<.05$.