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Changes in Heavy Drinking Over the Third Decade of Life as a Function of Collegiate Fraternity and Sorority Involvement: A Prospective, Multilevel Analysis

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Although affiliation with a fraternity or sorority is an important risk factor for heavy drinking, recent research indicates that this risk may be limited to the college years. Random coefficient growth modeling was used to track changes in patterns of heavy drinking over the course of 11 years as a function of gender and collegiate Greek involvement ($N = 318$). Overall, greater cumulative exposure to the Greek system led to increased heavy drinking during the college years, particularly among men. Shortly after leaving college, heavy drinking levels dropped markedly and remained low through approximately age 30. Inclusion of peer alcohol use norms in the model reduced the influence of Greek involvement. Implications for models of heavy drinking and health risks are discussed.

Key words: heavy drinking, fraternity and sorority involvement, peer norms, adult development, piecewise growth modeling

There is considerable evidence indicating that alcohol use generally tends to increase during late adolescence, peak during the early twenties, and decline thereafter, a pattern sometimes called *maturing out* (e.g., Chen & Kandel, 1995; Gotham, Sher, & Wood, 1997; Jessor, Donovan, & Costa, 1991; Muthen & Muthen, 2000; Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996). Most researchers agree that even heavy drinking is often a normative (e.g., Wechsler, Dowdall, Maenner, Gledhill-Hoyt, & Lee, 1998) but developmentally limited (Zucker, 1994) feature of early young adulthood (e.g., Gotham et al., 1997; Schulenberg et al., 1996). This pattern is particularly evident in studies using college student samples: College attendance itself is a risk factor for heavy drinking (Bachman, Wadsworth, O'Malley, Johnston, & Schulenberg, 1997), and decreases in heavy drinking in college samples generally are linked to the adoption of adult role responsibilities such as full-time employment and marriage following graduation (e.g., Chen & Kandel, 1995; Muthen & Muthen, 2000; Wood, Sher, & McGowan, 2000).

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Nevertheless, serious health risks frequently accompany heavy and binge drinking both during college (e.g., Engs, Diebold, & Hanson, 1996; Wechsler, Kuo, Lee, & Dowdall, 2000) and beyond (e.g., Wiscott, Kopera-Frye, & Begovic, 2002). For example, heavy drinking during college is associated with risky sexual behaviors (e.g., Cooper, 2002) and accidental injury (e.g., Perkins, 2002), among other risks. Continuation of heavy drinking beyond college not only prolongs these risks but also contributes to increased risk for specific disease morbidity and all-cause mortality. Despite evidence that moderate alcohol use might afford some protection against cardiovascular disease, heavy drinking patterns have been linked to increased risk for Type II diabetes (e.g., Wannamethee, Shaper, Perry, & Alberti, 2002) and coronary artery disease, cardiac arrhythmias, and stroke, among other disorders (for a review, see Puddey, Rakic, Dimmitt, & Beilin, 1999). Heavy drinking also contributes to morbidity and mortality indirectly by increasing the risk of accidents (e.g., Hingson & Howland, 1993). As such, it is important to know whether or how drinking patterns change to predict changes in associated risks over time (O'Neill, Parra, & Sher, 2001).

Heavy Drinking and Developmental Transitions

The current article focuses on changes in heavy drinking that take place during transitions across two theoretically distinct periods of development: emerging adulthood (incorporating the college years; Arnett, 2000) and young adulthood. Arnett defines emerging adulthood as the period following adolescence and preceding later adulthood, between approximately ages 18 and 25. In the current study, we refer to the emerging adulthood period as *the college years* because all members of our sample attended college for at least 4 years. According to Arnett (2000), emerging adult-

hood is distinguished by relative independence both from adult social roles and responsibilities and from the societal norms related to career and family faced by individuals in later young adulthood. This time period is also characterized by increased alcohol use (Chen & Kandel, 1995; Gotham et al., 1997).

Studies in the substance abuse literature that use cross-sectional research designs are unable to model dynamic processes such as the changes in heavy drinking associated with developmental transitions (see Sher & Trull, 1994). The growth modeling approach used in the current study, however, is ideally suited for this purpose. In addition to allowing the college years and later young adulthood to be modeled as distinct periods of time with different alcohol use trajectories (i.e., a piecewise two-rate model; see Bryk & Raudenbush, 1992; Li, Duncan, & Hops, 2001), this approach also permits examination of the rate of change associated with this developmental transition. The maturing out effect may best be characterized as a steady but slow drop in heavy drinking levels following an individual's early 20s. If so, a two-rate model with continuous trajectories over the college and postcollege years should best fit the observed data. However, the rapid changes in environmental structure that often accompany leaving college (e.g., full-time employment, relocation) might result in similarly rapid changes in heavy drinking. If so, modeling an abrupt change in heavy drinking trajectories during this developmental transition will provide a better fit to longitudinal drinking data.

Heavy Drinking and Collegiate Fraternity and Sorority Involvement

An important risk factor for heavy drinking and its consequences within college student populations is involvement in a fraternity or sorority. The fact that fraternity and sorority members (Greeks) drink more frequently, more heavily, and experience more alcohol-related problems during college than their nonaffiliated peers is well documented (e.g., see Alva, 1998; Borsari & Carey, 1999; Cashin, Presley, & Meilman, 1998). However, a recent study by Sher, Bartholow, and Nanda (2001) indicates that collegiate Greek membership per se may not have specific consequences for heavy drinking later in life. In that study, heavy drinking during college and 3 years later was predicted from collegiate Greek membership status. Findings indicated that although Greek members consistently drank more heavily during college, collegiate Greek status did not predict postcollege levels of heavy drinking (after controlling for freshman year heavy drinking levels). Sher et al. (2001) interpreted these findings as evidence that the social environment plays a key role in determining heavy drinking among Greek members. However, some researchers have questioned the short-term nature of these findings. For example, in responding to the findings of Sher et al. (2001), Wechsler (as cited in Eisner, 2001) argued that some heavy drinkers may curtail their alcohol use for limited periods of time, and therefore examining patterns of heavy drinking at one time point is not an adequate test of long-term changes in drinking behavior. In other words, those whose heavy drinking decreases after college may resume a heavier pattern of use later in life, perhaps once other transitions have taken place. Such a rebound effect might be expected if the influence of stable individual differences related to heavy drinking or learning increases once new environmental factors are more firmly in place.

Mechanisms of Effect

In addition to understanding the relationship between Greek involvement and heavy drinking trajectories, one should consider variables that might account for Greek involvement effects (i.e., third variables). Research shows that Greeks hold particularly biased beliefs concerning peers' drinking levels (e.g., Baer, 1994; Carter & Kahnweiler, 2000; Larimer, Irvine, Kilmer, & Marlatt, 1997; see also Borsari & Carey, 1999) and that alcohol and alcohol-related expectations are a central feature of the socialization practices and overall climate of many Greek organizations (Borsari & Carey, 1999; Carter & Kahnweiler, 2000; Dorsey, Scherer, & Real, 1999). It is clear from our own research on this issue (Sher et al., 2001), as well as other relevant work (e.g., Baer, Stacy, & Larimer, 1991; Collins, Parks, & Marlatt, 1985), that such contemporaneous social–environmental factors play an important role in determining heavy drinking among college students, and especially among Greek members.

However, other variables also may play a role in determining heavy drinking among Greek members, particularly those variables that relate to self-selection into the Greek system. Extensive research indicates that temperament dimensions related to behavioral disinhibition (e.g., novelty seeking, impulsivity), and to some extent sociability (e.g., extraversion), are associated with heavy drinking (see Sher, Trull, Bartholow, & Veith, 1999). Individuals with these traits may pursue a heavy drinking lifestyle in college and seek out environments (e.g., the fraternity or sorority house) that facilitate it.

Assessing Greek Involvement

Nearly all studies in this literature have conceptualized involvement in fraternities and sororities as a dichotomy. This approach could potentially overlook several important distinctions. For example, not everyone who joins a fraternity or sorority will remain in the organization throughout college, and some individuals may not join until late in their college careers. Furthermore, individuals who are not technically members of a fraternity or sorority but who closely associate with members (e.g., by frequently attending parties) also should be influenced by the social environment of the Greek system and therefore may experience many of the same effects on heavy drinking. Finally, some Greek members might limit their exposure to those aspects of Greek life that result in increased heavy drinking. If, as we have argued, the central issues in determining heavy drinking among those in the Greek system are socialization factors, then those who spend the most time in and are most involved with the social environment of the Greek house should be more strongly influenced by those factors than those who are less involved. To the extent that Greek involvement serves as a risk factor for heavy drinking, increased exposure might be associated with increased risk.

The Current Study

The goals adopted for this study were to examine trajectories of heavy drinking over two conceptually distinct periods of development—in part to address concerns that changes made during emerging adulthood might not hold into later developmental periods once other transitions have taken place and in part to test

which growth models (continuous or discontinuous) provide the best fit for the data—and to model the influence of theoretically important third variables on heavy drinking trajectories through the 3rd decade of life. Greek involvement was conceptualized in terms of cumulative exposure to a risk factor for heavy drinking. Specific hypotheses advanced for this study included (a) that heavy drinking trajectories would show a characteristic pattern of initial increase during the college years followed by a decrease during the postcollege years; (b) that levels of Greek involvement would significantly influence the levels and trajectories of heavy drinking during the college years but not the postcollege years; and (c) that modeling the influence of peer heavy drinking norms, and possibly temperament dimensions, would reduce the effects of college Greek involvement on heavy drinking.

Method

Participants and Procedure

Baseline screening. An extensive description of participant recruitment and ascertainment procedures was provided by Sher, Walitzer, Wood, and Brent (1991) and is briefly reviewed here. Approximately 80% (N = 3,156) of all incoming, first-time freshman at a large, midwestern university were screened for the presence of alcoholism in biological parents using versions of the Short Michigan Alcoholism Screening Test (SMAST; Selzer, Vinokur, & van Rooijen, 1975). Approximately 26% (n = 808) of participants in the screening sample were tentatively classified as either family history positive (FH+) or family history negative (FH−) on the basis of their SMAST scores (the remainder had intermediate SMAST scores and were not assessed further). Portions of the Family History—Research Diagnostic Criteria interview (FH–RDC; Endicott, Andreasen, & Spitzer, 1978) were administered to 97% of potential FH+ participants (n = 362) and to 413 FH− participants. The participants whose biological fathers met both SMAST and FH–RDC criteria for alcoholism were then classified as FH+, and participants whose first-degree relatives did not meet either SMAST or FH–RDC criteria for alcoholism, drug abuse, or antisocial personality disorder and whose second-degree relatives did not meet FH–DRC criteria for alcohol or drug abuse were classified as FH−. Because of a very low base rate, participants whose biological mothers but not fathers were alcoholic (n = 20) were not retained for further study. Participants also were excluded because of inconsistency between SMAST scores and FH–RDC interviews (n = 154) and because of concern for possible substance use disorder and antisocial personality disorder in relatives of our FH− participants (n = 33). The sample targeted for further study (n = 489) was composed of roughly equal numbers of male and female offspring of alcoholics and controls (ns ranging from 113 to 134).[1] The mean age of this sample (at screening) was 18.2 years. Of the participants, 94% were White, 4% were Black, 1% were Asian, and less than 1% were Native American and Hispanic.

Participants were assessed at baseline (Year 1) when they were freshmen, at three subsequent yearly intervals (Years 2, 3, and 4; corresponding to the sophomore, junior, and senior years of college), again 3 years later at Year 7, and again 4 years later at Year 11. For each annual assessment in which they took part, participants received either course credit (if enrolled in introductory psychology) or were paid $25 (at Years 1–4) or $75 (at Year 7) plus an additional stipend to cover travel expenses. At Year 11, all participants were paid $125 (plus travel costs).

Present study sample. Although efforts were made to assess all participants from the initial baseline sample at each year of the study, not all participants were retained. By Year 11, individuals who refused further participation (n = 49), whom we were unable to schedule (n = 23), or who were deceased (n = 7), were no longer in the data set. The remaining sample size at Year 11, therefore, was 410 (84% of participants targeted for follow-up). Because of participant relocation away from the area, some were interviewed via telephone and mailed a questionnaire. At Year 11, 44% of participants were assessed in this way. An additional 14 individuals completed interviews at Year 11 but did not provide questionnaire data, leaving the sample size of participants with all completed information at 396. For purposes of the current study, participants were excluded from the sample if they were not continuously enrolled at a college or university as full-time students throughout the first 4 years of the study (n = 170 from the initial follow-up sample of 489; 57% were men and 43% were women, 41% were Greek members while in school). As a result, the final sample available for analyses in the present study consisted of 318 participants (42% male, 58% female; 64% self-identified as members of Greek organizations during at least 1 college assessment year). The mean age of the sample at Year 11 was 29.5 years.

Measures

Fraternity or sorority involvement. At each assessment during the college years, participants indicated their degree of affiliation with a fraternity or sorority using the following scale: *active member* (0), *a little sister or houseboy* (1), *a nonmember who frequently associated with members (e.g., regular attendance at fraternity parties)* (2), *a nonmember who occasionally associated with members* (3), or *not at all affiliated* (4). Response options were reverse coded. In addition, participants answered a separate item indicating their type of residence (dorm, apartment, fraternity or sorority house, condo or single family home). In the current study, responses to this item were considered in conjunction with the fraternity or sorority involvement item to yield the following scale: 0 = *not affiliated,* 1 = *a nonmember who occasionally associated with members,* 2 = *a nonmember who frequently associated with members,* 3 = *a little sister or houseboy,* 4 = *an active member who did not live in the house,* and 5 = *an active member who lived in the house.* Hence, cumulative scores for the college Greek involvement variable ranged from 0 to 20 (i.e., scores ranged from 0 to 5 for each of the 4 college years). In the current sample, the mean Greek involvement score for men was 8.2 (SD = 7.90; interquartile range = 18); the mean for women was 7.73 (SD = 6.90; interquartile range = 14). The overall mean was 7.91 (SD = 7.32), although a considerable number of participants were represented by scores less than 2 (n = 96; 30%) or greater than 17 (n = 63; 20%). Cumulative exposure for each participant at each year also was calculated as the sum of the Greek involvement scores up to a given year.

Alcohol use. At each year of the study, participants estimated their alcohol involvement during the previous 30 days and also during the past year by answering questionnaire items. Heavy alcohol involvement was assessed by obtaining per week estimates for the number of times high from alcohol, the number of times drunk, and the number of heavy drinking occasions (number of times consuming five or more drinks in a single sitting; i.e., binges) based on the past month. For these items, response options ranged from 0 (*didn't get high/drunk/have 5 or more drinks at one time in past 30 days*) to 7 (*did so every day*). For the current study, a heavy drinking composite variable (HEAVY) was created by calculating the mean of the heavy alcohol involvement items (alpha coefficients for the composite ranged from 0.91 at Year 1 to 0.81 at Year 11). The items composing this composite have been shown to correlate similarly with alcohol-related problems both cross-sectionally and prospectively (O'Neill et al., 2001). As such, despite some potential concerns related to redun-

[1] Although examining the effects of family history (FH) of alcoholism on heavy drinking trajectories was not a goal of this study, because of initial over-sampling of FH+ individuals, all models reported here were replicated using FH status. Including FH did not change the nature of any of our conclusions (i.e., FH was not a significant predictor and did not produce any significant interactions with other predictors), and as such we do not discuss it further.

dancy among the items and conceptual distinctions among items assessing subjective effects and drinking behavior, we believe that averaging across these items is reasonable (see also Sher et al., 2001). Across study years, correlations among the items making up this composite ranged from .43 to .81 (all *p*s $< .01$).

Peer norms. Perceptions of norms regarding peer alcohol use and peer support for heavy drinking were measured using six items assessing how one's friends feel about drinking and about getting drunk, the number of close friends who drink, how much close friends drink, how often they get drunk, and how many drink primarily to get drunk. Numbers of close friends who drink, who drink to get drunk, and who get drunk regularly were assessed using Likert-type scales with options ranging from 0 (*None*) to 4 (*Nearly All*). Response options for items concerning how close friends feel about drinking and getting drunk ranged from 0 (*Strongly Disapprove*) to 4 (*Strongly Approve*). A similar scale was used to assess how much close friends typically consume when drinking from 0 (*they don't drink*) to 4 (*more than 6 drinks*). Responses on these items were averaged to form a composite peer norms variable for the present study. Alphas ranged from .89 to .95 over the six waves of assessment.

Temperament dimensions. At Year 1, participants completed the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975), which consists of 90 items designed to assess the personality traits of extraversion, neuroticism, and psychoticism, and the Tridimensional Personality Questionnaire (TPQ; Cloninger, 1987), which consists of 98 items designed to assess the personality traits of novelty seeking, harm avoidance, and reward dependence. For the purposes of the current study, the Extraversion subscale of the EPQ (EPQ–E; $\alpha = .83$) served as a measure of extraversion–sociability, and the Psychoticism subscale of the EPQ (EPQ–P; $\alpha = .63$) and the Novelty Seeking subscale of the TPQ (TPQ–NS; $\alpha = .80$) were used as measures of impulsivity–disinhibition (see Sher et al., 1999).

Results

Bivariate Associations

Table 1 presents simple bivariate correlations among gender and family history status, Greek involvement (cumulative up to each assessment), HEAVY, temperament dimensions, and peer norms. As expected, HEAVY and Greek involvement were significantly correlated throughout the college years, indicating that students who were more involved in the Greek system also were drinking more heavily. The correlation between heavy drinking and Greek involvement was substantially reduced during the postcollege years (Year 7 and Year 11), although a significant relationship was still evident. However, the simple associations presented in Table 1 do not control for baseline levels of heavy drinking (which could be due in part to selection factors), and given that levels of postcollege heavy drinking are partially a function of precollege heavy drinking levels, the specific effects of collegiate Greek involvement are unclear. A more specific test of the relation between Greek involvement and HEAVY is presented below using prospective regression equations controlling for baseline levels of heavy drinking.

The peer norms composite was significantly correlated with both heavy drinking and cumulative Greek involvement at each assessment. Aside from a modest association at Year 1, family history of alcoholism was not significantly correlated with HEAVY. Family history also did not correlate with Greek involvement. Finally, with respect to temperament dimensions, both baseline indices of impulsivity–disinhibition (EPQ–P and TPQ–NS) showed consistent relations with both heavy drinking and peer norms, but neither was related to Greek involvement. In contrast, extraversion–sociability (EPQ–E) showed a consistent positive relation to Greek involvement throughout the college years but was related to heavy drinking only in Years 1 and 2. EPQ–E also was modestly related to peer norms in the first two years, but the magnitude of this relation decreased substantially in later assessments.

Prospective Regression Analyses

In these analyses, HEAVY was predicted from the level of cumulative Greek involvement up to the previous year, controlling for gender, the Greek × Gender interaction, and baseline (Year 1) heavy drinking. This analysis revealed that Greek involvement during Year 1 significantly predicted HEAVY in Year 2 ($\beta = .18$, $p < .01$) and that cumulative Greek involvement to Year 3 predicted HEAVY in Year 4 for men ($\beta = .23$, $p < .01$) but not women ($\beta = .03$, $p > .20$). However, cumulative level of Greek involvement up to Year 2 did not reliably predict HEAVY at Year 3 after controlling for baseline heavy drinking ($\beta = .06$, $p > .15$). More important for the current study, after baseline drinking levels were controlled, cumulative Greek involvement during college did not significantly predict heavy drinking during the later developmental periods we examined (βs = .03, and .05, for Year 7 and Year 11, respectively, *p*s $> .20$). Gender was a significant prospective predictor at each year (βs ranged from .15 to .23, *p*s $< .01$) as was baseline heavy drinking (βs ranged from .49 at Year 2 to .31 at Year 11, *p*s $< .01$).

Growth Models

Each growth model describes a series of heavy drinking trajectories for men and women at various levels of Greek exposure (i.e., growth parameters depend on gender and Greek involvement). Several model revisions were attempted to improve the fit of our model with the dynamic nature of heavy drinking during these periods. First, we constructed a base model estimating simple linear growth over the entire 11-year study period. Next, given the theoretical (e.g., Arnett, 2000) and substantive (e.g., Bachman et al., 1997; Chen & Kandell, 1995; Schulenberg et al., 2001) importance of conceptualizing the college years and young adulthood as distinct periods of development, a piecewise modeling strategy was used to uniquely identify patterns of heavy drinking during the college years and during the postcollege years (e.g., Li et al., 2001; see also Bryk & Raudenbush, 1992). Next, we constructed a revised piecewise model including a discontinuity in the trajectories at Year 4, representing a level change thought to coincide with abrupt changes in environmental structure (and heavy drinking) taking place between Year 4 and Year 7 (i.e., maturing out). Finally, to test the influence of potential mediators of Greek involvement effects, we presented an additional piecewise, discontinuous trajectory model controlling for the influence of peer norms. In all of these models, the intercept was defined at Year 1. The Greek involvement variable was centered prior to analyses to reduce nonessential collinearity with interaction terms (Aiken & West, 1991). The growth models were estimated by restricted maximum likelihood using SAS PROC MIXED (Version 8.0).

Model comparisons. Table 2 shows the deviance change values (and degrees of freedom) associated with each model we

Table 1
Bivariate Correlations Among Cumulative Greek Involvement Scores, Heavy Drinking, Gender, and Family History at Each Assessment Year

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. FH	—														
2. Gender	.06	—													
3. HEAVY 1	.11*	−.11*	—												
4. HEAVY 2	.05	−.21**	.54**	—											
5. HEAVY 3	.00	−.19**	.47**	.51**	—										
6. HEAVY 4	.07	−.29**	.54**	.57**	.53**	—									
7. HEAVY 7	.09	−.26**	.38**	.38**	.42**	.51**	—								
8. HEAVY 11	.06	−.21**	.35**	.35**	.31**	.47**	.43**	—							
9. Greek 1	.06	−.03	.14**	.26**	.13*	.18**	.08	.09	—						
10. Greek 2	.03	−.02	.17**	.27**	.16**	.20**	.09	.11	.91**	—					
11. Greek 3	.01	−.02	.19**	.27**	.20**	.24**	.11*	.11*	.86**	.97**	—				
12. Total Greek	.02	−.03	.21**	.28**	.21**	.24**	.12*	.13*	.82**	.94**	.98**	—			
13. EPQ–E	−.01	.13*	.18**	.17**	.06	.09	.06	.10	.19**	.18**	.18**	.18**	—		
14. EPQ–P	.14*	−.22**	.33**	.23**	.32**	.27**	.34**	.20**	.01	.00	.00	−.05	−.06	—	
15. TPQ–NS	.13*	−.10	.38**	.23**	.17**	.22**	.14*	.07	.08	.08	.08	.06	.18**	.40**	—
Peer Norms 1	.14*	−.20**	.54**	.46**	.38**	.49**	.34**	.28**	.27**	.27**	.27**	.28**	.25**	.29**	.37**
Peer Norms 2	.13*	−.19**	.52**	.55**	.40**	.47**	.34**	.30**	.28**	.30**	.30**	.29**	.22**	.31**	.32**
Peer Norms 3	.04	−.20**	.50**	.54**	.48**	.55**	.38**	.34**	.26**	.29**	.30**	.30**	.11*	.27**	.27**
Peer Norms 4	.05	−.29**	.50**	.51**	.46**	.60**	.41**	.35**	.25**	.27**	.29**	.30**	.12*	.23**	.28**
Peer Norms 7	.03	−.22**	.42**	.48**	.40**	.52**	.58**	.44**	.20**	.20**	.21**	.21**	.08	.20**	.21**
Peer Norms 11	.11	−.26**	.41**	.50**	.45**	.51**	.57**	.56**	.24**	.25**	.26**	.27**	.09	.27**	.19**

Note. For each assessment, sample sizes were 318 (Years 1–4), 304 (Year 7), and 278 (Year 11). Correlations among the peer norms composite variable at each assessment (not shown here) were all ≥.50 ($ps < .01$). FH = family history status (1 = FH+, 0 = FH−); HEAVY = the heavy drinking composite variable as measured at Years 1–11; Greek = cumulative Greek involvement scores up to each year; Total Greek = total cumulative Greek involvement for the college years; EPQ–E = Extraversion subscale of the Eysenck Personality Questionnaire; EPQ–P = Psychoticism subscale of the Eysenck Personality Questionnaire (serves as an index of impulsivity and disinhibition); TPQ–NS = Novelty Seeking subscale of the Tridimensional Personality Questionnaire (serves as an index of impulsivity and disinhibition); Peer norms = peer norms composite variable as measured at Years 1–11.
* $p < .05$. ** $p < .01$.

Table 2
Comparison of Fit of Growth Models Estimating Heavy Drinking Over 11 Years

Model form	Random effects	Deviance value (ML/REML)	Deviance Δ	*df*
1. Base model	Int	6,839.25		
		↓		
2. Two rate, continuous	Int	3,587.80/3,686.42	3,251.45**	4
		↓		
3. Two rate, continuous	Int, CYS	3,554.37/3,652.94	33.48**	3
		↓		
4. Two rate, discontinuous	Int, CYS	3,541.13/3,659.42	13.24*	4
		↓		
5. Two rate, discontinuous	Int, CYS, Y4dis	3,476.41/3,595.58	63.84**	3

Note. Deviance values for all but the base model are reported as those based on maximum likelihood estimation (ML)/those based on restricted maximum likelihood estimation (REML). Vertical arrows in the deviance value column indicate whether the appropriate comparison between two successive models is for the deviance value based on ML or REML. Int = intercept; CYS = college years slope; Y4dis = discontinuity in trajectories (e.g., level change) at Year 4.
* $p < .05$. ** $p < .01$.

estimated. The fit of models that differ in their fixed effects is based on maximum likelihood estimation, whereas fit of models with identical fixed effects comparing variance components (i.e., random effects) is based on restricted maximum likelihood. It is clear from the very large deviance change between the base model and the two-rate model that the latter provides a much better fit to the data, indicating that estimating separate trajectories for the college years and postcollege years is preferable. Hence, interpretation of the coefficients in the base model is not warranted, and we do not discuss it further. It is also evident that including the college years slope as a random effect along with the intercept improved model fit. Finally, Table 2 shows that the model with discontinuous slopes provided a better fit to the data than the model with continuous slopes and that including the discontinuity variable as a random effect further improved model fit. In the sections that follow, we present detailed descriptions of the two main piecewise models (Models 3 and 5 from Table 2). In the model with continuous trajectories, the intercept and college years slope were included as random effects.[2] In the discontinuous trajectories model, the additional discontinuity variable also was included as a random effect. All other variables (i.e., Greek involvement, gender, and all interactions) were included as fixed effects in both models.

Piecewise models with continuous and discontinuous trajectories. Figure 1 presents illustrative trajectories of heavy drinking behavior with continuous slopes during the college and postcollege years for men and women with high (19), mean (7.91), and low (0) levels of Greek involvement. These levels were chosen because they represent meaningful numbers of individuals at distinctly different levels of Greek involvement. The significant improvement in model fit associated with the inclusion of a discontinuity in the slopes at Year 4 (see Table 2) indicates that the gradual decrease in heavy drinking over the postcollege years depicted in Figure 1 does not accurately represent the true nature of the change in heavy drinking. Figure 2 presents these trajectories according to the discontinuous slopes model.

As shown in Table 3, coefficients associated with many of the fixed effects obtained from these models are similar. Both models show that being male and being involved in the Greek system were associated with increased heavy drinking at Year 1. Also, heavy drinking trajectories during the college years differed for men and women, as indicated by the significant interaction involving gender and the college years slope in both models. In the discontinuous trajectories model, this interaction was further qualified by Greek involvement. Inspection of the simple slopes for men and women at various levels of Greek involvement indicated that, whereas the heavy drinking of men with average (estimate = .03, $p < .10$) and high (estimate = .07, $p < .05$) levels of Greek involvement tended to increase during college, heavy drinking among men with low Greek involvement did not change reliably (estimate = .01, $p > .50$). In contrast, heavy drinking among women with average (estimate = −.05, $p < .01$) and high (estimate = −.08, $p < .01$) levels of Greek involvement tended to decrease during the college years relative to Year 1, whereas heavy drinking among women with low Greek involvement did not change reliably during this time (estimate = −.02, $p > .30$). One should note, however, that women involved in the Greek system did show higher levels of heavy drinking initially than women with less involvement. In addition, although Greek involvement significantly influenced the overall level of heavy drinking, Greek involvement did not appear to change the slope of the trajectory for HEAVY during the college years.

The main differences between these models are evident in the coefficients for the postcollege trajectories. Although both models indicate that, as predicted, heavy drinking decreased significantly during the postcollege years, the inclusion of the level change at Year 4 altered the interpretation of many interaction effects associated with the postcollege slope. In the continuous trajectories

[2] We also tried to model the postcollege slope as a random effect. However, in the presence of the other covariates (i.e., Greek involvement and gender main effects and interaction), there was no significant variability associated with the postcollege slope. Therefore, the models we present include the postcollege slope as a fixed effect only. One should note, however, that inclusion of the postcollege slope as a random effect in ancillary analyses produced coefficients for fixed effects virtually identical to those we report.

model, for example, the slope for the postcollege years is seen to decline more for those heavily involved in the Greek system and more for men than for women, particularly for men heavily involved in the Greek system (estimate = −.12, *SE* = .02, $p < .01$). The model with discontinuous slopes makes clear that the majority of the variance in postcollege trajectories is accounted for between Years 4 and 7. This pattern is most evident in the significant interaction involving gender, Greek involvement, and the Year 4 discontinuity (representing the level change between the college years slope and the postcollege slope). Inspection of the trajectories in Figure 2 clearly shows that men with higher levels of college Greek involvement experienced the steepest drop in heavy drinking levels as predicted by the postcollege slope. The simple coefficients confirm that this change was significant for men with high Greek involvement (estimate = −.59, *SE* = .17, $p < .01$) and marginally so for men with mean levels of Greek involvement (estimate = −.19, *SE* = .10, $p < .06$), but not for men with low levels of Greek involvement (estimate = .09, *SE* = .14, $p > .50$). The change was not significant for women, regardless of Greek involvement (estimates = −.08, ps $> .30$, for all levels).

Comparison of the random effects for these two models indicates that inclusion of the discontinuity between the college years and postcollege years resulted in the model accounting for slightly more of the variance in the intercept than in the continuous trajectories mode. However, significant intercept variability remains, indicating that variables not included in our models play an important role in determining heavy drinking during these years. Also, the variance in the college years slope is better accounted for by the latter model.

The influence of peer norms and extraversion. As reviewed previously, peer norms appear to play a key role in determining alcohol use among college students, and particularly those involved in the Greek system (e.g., Baer et al., 1991; Collins et al., 1985; Sher et al., 2001). Thus, controlling for the influence of peer norms in our growth models should substantially reduce the size of the Greek effect and as a consequence should decrease the variability in the trajectories for individuals with varying levels of Greek involvement. The following analyses were designed to test

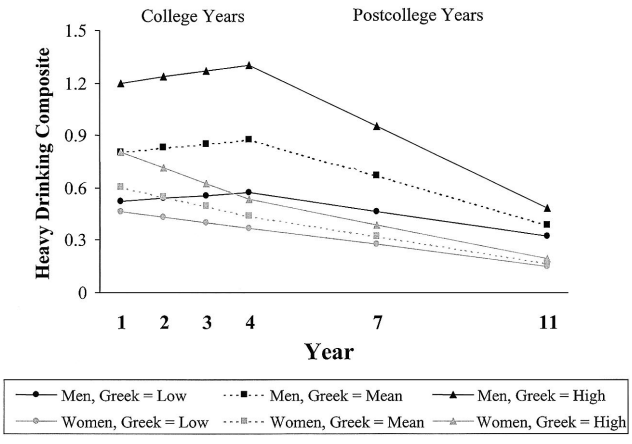

Figure 1. Growth model of heavy drinking during the college and postcollege years as a function of gender and level of collegiate Greek involvement. Representative levels of the Greek involvement variable are as follows: Low Greek = 0, Mean Greek = 7.9, High Greek = 19.

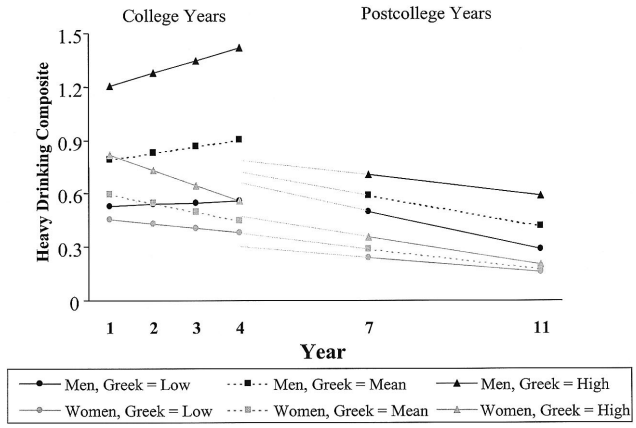

Figure 2. Growth model with discontinuous trajectories of heavy drinking during the college and postcollege years, as a function of gender and level of Greek involvement. Representative levels of the Greek involvement variable are as follows: Low Greek = 0, Mean Greek = 7.9, High Greek = 19. The lighter lines between Year 4 and Year 7 represent estimated trajectories based on the modeled level change that took place sometime between these two assessments.

this possibility in our two-rate growth model with discontinuous slopes. Because peer norms were assessed at each year of the study, the peer norm composite variable was included as a time-varying covariate to allow for its influence to change over time along with heavy drinking.[3]

Heavy drinking trajectories after controlling for peer norms are presented in Figure 3, and the coefficients associated with this model are presented in the right column of Table 3. Inspection of Table 3 shows that the coefficient associated with Greek involvement in this model was markedly reduced. The significant interaction involving peer norms and gender suggests that the norms variable was differentially effective in reducing Greek involvement effects for men and women. However, comparison of models separately for men and women indicated that inclusion of peer norms in the model reduced the size of the Greek effect by approximately 50% for men, from .034 ($p < .01$) to .017 ($p < .01$), and by approximately 60% for women, from .018 ($p < .05$) to .007 ($p > .25$). Hence, although the Greek involvement effect was similarly reduced for men and women, the change resulted in a nonsignificant residual value among women only. The interaction of Greek involvement and the Year 4 discontinuity (and also the 3-way interaction including gender) remained largely unaffected in this model, indicating that controlling for norms did not eliminate Greek involvement effects on heavy drinking trajectories. Of interest, including peer norms in the model functionally eliminated the influence of gender on heavy drinking. The vari-

[3] One should note that although testing for a reduction in the size of the Greek effect in the presence of the norms or temperament variables is consistent with a mediational approach, it does not represent the idealized treatment of the complex set of relations implied by a mediational model. Then-current state-of-the-art treatments of mediation in multilevel models did not involve time-related components (cf. Krull & MacKinnon, 2001; Raudenbush & Sampson, 1999), a limitation that led us to adopt the approach used here.

Table 3
Coefficients Predicting Heavy Drinking (and Standard Errors) in the Three Growth Models of Interest

Variable	Continuous trajectories		Discontinuous trajectories		Controlling for peer norms	
	Est	*SE*	Est	*SE*	Est	*SE*
Fixed effects						
Year 1 intercept	.805**	.066	.796**	.006	.713**	.054
College years slope (CYS)	.024	.022	.036†	.022	.025	.021
Postcollege years slope (PCS)	−.070**	.009	−.042**	.009	−.047**	.017
Year 4 discontinuity (Y4dis)	—	—	−.191*	.100	−.145	.098
Gender	−.202*	.086	−.197*	.086	−.070	.071
Greek involvement	.035**	.008	.034**	.008	.017*	.007
Peer alcohol norms composite	—	—	—	—	.075**	.005
Peer Norms × Gender	—	—	—	—	−.020**	.007
Gender × Greek Involvement	−.017	.012	−.016	.012	−.010	.009
CYS × Greek Involvement	.001	.003	.003	.003	.003	.002
PCS × Greek Involvement	−.004**	.001	.001	.001	.000	.002
CYS × Gender	−.079**	.028	−.086**	.028	−.069*	.028
PCS × Gender	.031**	.012	.015	.012	.021	.022
Y4dis × Gender	—	—	.107	.132	.044	.128
Y4dis × Greek Involvement	—	—	−.036**	.013	−.030*	.012
CYS × Gender × Greek Involvement	−.004	.004	−.006†	.004	−.007†	.004
PCS × Gender × Greek Involvement	.003*	.001	−.002	.001	−.001	.003
Y4dis × Gender × Greek Involvement	—	—	.036*	.018	.036*	.017
Random effects (variance components)						
Intercept	.370**		.320**		.180**	
CYS	.008*		.001		.003	
Y4dis	—		.010		.006	

Note. Gender is coded 0 = Male. Greek involvement was centered at the mean prior to analysis. Dashes indicate parameters that were not estimated in a given model. Est = estimate of coefficient predicting heavy drinking.
† $p < .10$. * $p < .05$. ** $p < .01$.

ability in the intercept also was reduced markedly by controlling for peer norms, although the residual variability remained significant, indicating that other variables importantly influence baseline heavy drinking levels.

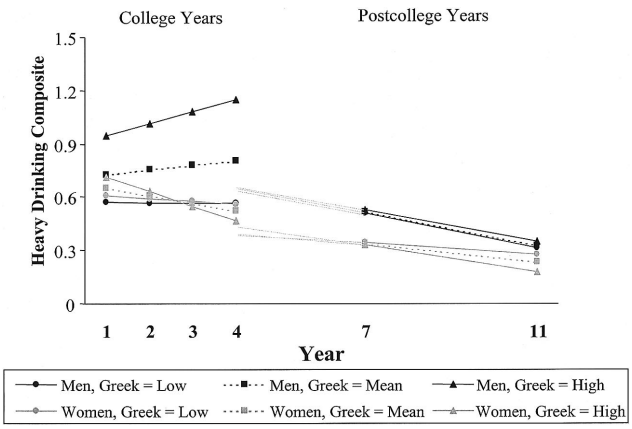

Figure 3. Trajectories of heavy drinking during the college and postcollege years after controlling for the influence of peer alcohol involvement norms. The lighter lines between Year 4 and Year 7 represent estimated trajectories based on the modeled level change that took place sometime between these two assessments.

That Greek involvement remained a significant predictor of heavy drinking after controlling for peer norms suggests that other factors also play an important role in determining heavy drinking among Greeks (especially Greek men).[4] The zero-order correlations presented in Table 1 suggest that extraversion might be related to selection into the Greek system, and as such, could potentially confound the relation between Greek involvement and heavy drinking. If so, modeling the influence of extraversion should also reduce the Greek effects we observed. Hence, we constructed additional models in which scores on the EPQ–E scale were included as additional fixed effects along with the peer norms composite. However, inclusion of this variable failed to account for additional variance in Greek involvement effects. Furthermore, controlling for extraversion in the absence of peer norms did not substantially influence the size of the Greek involvement effect.

[4] Another possibility is that peer norms were not assessed in a sufficiently broad manner to capture all relevant variance. The larger, ongoing study of which the present article is a part was not designed to specifically examine the mediational role of peer norms, so the measure used may not have been ideal. In future examinations of this issue, it may be important to assess the influence of peer norms more systematically.

Discussion

Our previous work examining the influence of collegiate Greek membership on heavy drinking (Sher et al., 2001) suggested that the heavy drinking of fraternity and sorority members does not continue beyond the college years. A key finding of the present study is that this trend appears to generalize to a later developmental period (young adulthood), a time when people typically have adopted adult roles such as full-time employment and marriage. Examination of the trajectories from our piecewise growth model with discontinuous slopes (Figure 2) clearly shows that whereas higher levels of Greek involvement were associated with increased heavy drinking during the college years (at least among men), the postcollege years were characterized by a sharp drop in heavy drinking that primarily occurred between Years 4 and 7, particularly among men. By the end of the college years, women's heavy drinking already had declined to a relatively low and stable level. That high levels of Greek involvement influence slopes of heavy drinking in opposite directions for men and women suggests potentially important differences between fraternity and sorority alcohol-related socialization as the college years progress.

This pattern of results has important implications for predicting alcohol-related health outcomes into later adulthood. As noted previously, heavy and binge drinking patterns are associated with increased risks for cardiovascular disease morbidity and mortality (e.g., Puddey et al., 1999), in addition to increased risks for accidental injury and death (e.g., Hingson & Howland, 1993). Presumably, the marked decline in heavy drinking following the college years bodes well for those men with the highest levels of Greek involvement in terms of reducing their morbidity and mortality risks. The growth modeling approach used here revealed a subgroup of young men, heavily involved in the Greek system, whose heavy drinking appears to increase throughout college along with their exposure to the Greek environment. This pattern is in contrast to the more common decreasing trend in heavy drinking during later college years (e.g., Schulenberg et al., 2001) and suggests that these men are at elevated risk for alcohol-related injuries and sudden cardiac death during college (e.g., Puddey et al., 1999). More generally, the current findings indicate that social–environmental factors relate indirectly to cardiovascular disease risk through their strong influence on heavy drinking.

Theories related to the development of alcohol and other drug use throughout adolescence and emerging adulthood provide several plausible explanations for the changing heavy drinking trajectories noted here. For example, when viewed from a social control theory perspective (e.g., Shoemaker, 1990), the most important determinants of heavy drinking are environmental or structural influences such as neighborhoods, family structure, and the availability of alcohol. The transition from adolescence to early adulthood is marked by substantial changes in these structures, particularly for individuals who leave home to attend college. Parental controls and other associated factors are relaxed, and alcohol becomes much more readily available. However, theories of social learning and social development (e.g., Akers, 1977; Bandura, 1982; Hawkins & Weis, 1985) provide a useful framework for understanding why heavy drinking levels tend to decline rapidly after the college years. According to such theories, more proximal social influences such as peer group role models, learning opportunities, and reward structures are important determinants of drinking behavior. As individuals transition into adult roles following the college years, these proximal influences change as the individuals leave an environment in which heavy drinking is normative, encouraged, and rewarded, and enter environments with very different standards and reward structures (see also Bachman et al., 1997).

This same framework helps to explain the results of our analyses examining the influence of peer norms and extraversion on heavy drinking trajectories. We have argued that a major factor underlying the risk for heavy drinking in college is the social environment of the college campus—and of the Greek house in particular—and our peer norm analyses provide support for this view (see also Baer, 1994; Cashin et al., 1998; Sher et al., 2001). Controlling for peer norms not only substantially reduced the influence of Greek involvement on heavy drinking trajectories but also functionally eliminated the effects of gender on heavy drinking. This finding underscores the importance of peer norms in predicting heavy drinking for all college students (e.g., Baer, 1994; Baer et al., 1991) and suggests that even basic gender differences in alcohol involvement (e.g., Harford & Grant, 1994) are likely influenced by socialization factors. More generally, the size of the drop between the college and postcollege years was reduced when peer norms were controlled, suggesting that some portion of the maturing out effect is driven by changes in peer influences.

Nevertheless, significant variance in the effects of Greek involvement remained for men in our sample after controlling for peer norms, suggesting that other factors also play an important role in heavy drinking among Greek men. We were unable to find support for the hypothesized role of extraversion and disinhibition—temperament dimensions known to be associated with risk for substance use and abuse (Sher, Bartholow, & Wood, 2000) and that theoretically should not change with shifts in social and environmental structure—in accounting for Greek involvement effects. Still, other selection-related factors, such as levels of high school drinking, drinking motives, or proximal goals of attending college (e.g., to explore and have fun) may be important and were not assessed in this study. Another possibility is that additional social environment factors not measured in the current study might help to explain Greek involvement effects on heavy drinking. For example, the availability of alcohol has been shown to play a role in determining alcohol use among college students, and this may be especially true of fraternity and sorority residents (e.g., Borsari & Carey, 1999; Martin & Hummer, 1998; Wechsler et al., 2000).

Some of the methodological contributions of this study bear further comment. Our conceptualization of Greek involvement as a cumulative exposure variable is unique in this literature. The typical assessment of Greek involvement as a dichotomous membership variable implies that the influence of Greek involvement is the same regardless of how much or how often a person participates in activities within the Greek system. The fact that Greek involvement effects in the current study appeared to be graded suggests that Greek involvement functions in a manner similar to other socialization or environmental variables that can vary in intensity at any given point in time but also can accumulate across time. The growth modeling approach used here revealed potentially important gender differences in Greek involvement effects, which were not apparent when a hierarchical regression approach was used (see also Sher et al., 2001). These findings suggest that

the use of more complex modeling procedures can improve the specificity of findings in this literature.

Conclusion

The current study provides further evidence that the heavy drinking associated with collegiate Greek involvement does not generally lead to sustained heavy drinking later in life and that the social environment of the fraternity or sorority house is an important determinant of the heavy drinking associated with collegiate Greek involvement (Sher et al., 2001). Moreover, the current results show that the protective effects of leaving college appear relatively quickly, at least within the first 3 years after graduation, and suggest that leaving the campus environment is an important determinant of maturing out (and associated reductions in cardiovascular morbidity and other risks) among a subset of young men heavily involved in Greek life during college. Future research should be aimed at further examining the opposing effects of Greek involvement on trajectories of heavy drinking during college seen for men and women in this study, to better understand the role of Greek involvement in alcohol-related health risks.

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