

Social Network Influences on Initiation and Maintenance of Reduced Drinking Among College Students

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Objective: To determine whether (a) social networks influence the extent to which college students initiate and/or maintain reductions in drinking following an alcohol intervention and (b) students with riskier networks respond better to a counselor-delivered, vs. a computer-delivered, intervention. **Method:** Mandated students ($N = 316$; 63% male) provided their perceptions of peer network members' drinking statuses (e.g., heavy drinker) and how accepting each friend would be if the participant reduced his or her drinking. Next, they were randomized to receive a brief motivational intervention (BMI) or Alcohol Edu for Sanctions (EDU). In latent growth models controlling for baseline levels on outcomes, influences of social networks on 2 phases of intervention response were examined: initiation of reductions in drinks per heaviest week, peak blood alcohol content (BAC), and consequences at 1 month (model intercepts) and maintenance of reductions between 1 and 12 months (model slopes). **Results:** Peer drinking status predicted *initiation* of reductions in drinks per heaviest week and peak BAC; peer acceptability predicted initial reductions in consequences. Peer Acceptability \times Condition interactions were significant or marginal for all outcomes in the *maintenance* phase. In networks with higher perceived acceptability of decreasing use, BMI and EDU exhibited similar growth rates. In less accepting networks, growth rates were significantly steeper among EDU than BMI participants. For consumption outcomes, lower perceived peer acceptability predicted steeper rates of growth in drinking among EDU but not BMI participants. **Conclusions:** Understanding how social networks influence behavior change and how interventions mitigate their influence is important for optimizing efficacy of alcohol interventions.

Keywords: brief intervention, computer-delivered intervention, college drinking, alcohol abuse prevention, peer influence

College students are at increased risk for misusing alcohol relative to their noncollege-attending peers (Blanco et al., 2008; Slutske, 2005), and alcohol use increases markedly following the transition from high school to college (Baer, Kivlahan, Blume, McKnight, & Marlatt, 2001; Sher & Rutledge, 2007). Taken together, these patterns suggest that the residential college environment, characterized by greater personal freedoms and intense

peer interaction, promotes heavy alcohol use. Almost 45% of college students report a recent episode of heavy alcohol consumption (Hingson, Zha, Weitzman, Hingson, & Weitzman, 2009), resulting in serious consequences for both drinkers and their peers. Alcohol plays a role in 1,825 deaths, 599,000 injuries, 696,000 physical assaults, and 97,000 sexual assaults each year among college students (Hingson et al., 2009; Johnston, O'Malley, Bachman, & Schulenberg, 2011).

Interventions to reduce heavy alcohol use among college students vary in content and delivery context, reflecting a range of active ingredients and delivery modalities. Meta-analyses suggest that brief interventions, whether delivered by counselor or computer, produce initial reductions in alcohol use, consistent with small to medium effect sizes (Carey, Scott-Sheldon, Carey, & Demartini, 2007; Carey, Scott-Sheldon, Elliott, Garey, & Carey, 2012; Carey, Scott-Sheldon, Elliott, Bolles, & Carey, 2009). However, these effects begin to decay relatively soon following interventions. The effects of computer-delivered interventions tend to decay within 3 months, whereas the effects of counselor-delivered interventions begin to decay within 3–6 months, with few effects remaining by 12 months (Carey et al., 2012). Thus, improved understanding of the factors that hinder maintenance of behavior change is needed to develop interventions with more enduring effects. To the extent that, for treatment-seeking individuals, reducing and maintaining reductions in alcohol use depends on

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having a supportive social environment (Moos, 2007), college students' social networks may play an important role in intervention efficacy and maintenance.

Research on alcohol interventions for college students generally has not focused on factors that predict maintenance of behavior change. Further, no known research has examined whether initiation and maintenance of change in alcohol use depends on the attributes of college students' social networks. The present research sought to address this gap in the literature. We considered whether, following participation in a brief intervention, the extent to which college students initiated changes in alcohol use and maintained changes over time depended on their perceptions of the alcohol-related attitudes and behaviors of individuals in their social networks.

Theoretical models of health behavior suggest that social networks are likely to facilitate or constrain alcohol use. Social cognitive theory and the theory of planned behavior suggest that peers are likely to influence health through various channels, including modeling and normative perceptions (Ajzen, 1991; Bandura, 1998). Social ecological models view behavior as occurring within systems that are external to the individual, recognizing the interpersonal influence of family members and peers on health (Bronfenbrenner, 1979). From all of these perspectives, being a member of a social network in which heavy drinking is common and supported is likely to promote higher levels of individual drinking. If interventions do not address these social network influences either directly or indirectly, efficacy for producing behavior change would be expected to suffer.

Empirical research further supports an influence of social networks on college student drinking. Among college students, alcohol use occurs primarily with peers and is strongly influenced by peer behavior (Borsari & Carey, 2001; Christiansen, Vik, & Jarchow, 2002). Naturalistic social network studies, using both ego-centric, respondent-reported methods (e.g., Capaldi, Stoolmiller, Kim, & Yoerger, 2009; Lau-Barraco, Braitman, Leonard, & Padilla, 2012; Reifman, Watson, & McCourt, 2006) and sociocentric, peer-reported methods (e.g., Cruz, Emery, & Turkheimer, 2012; Rosenquist, Murabito, Fowler, & Christakis, 2010), show strong, positive associations between peer alcohol use and personal alcohol use. These associations reflect socialization processes, in which personal alcohol use is shaped by peer behavior, as well as selection processes, in which individuals affiliate with peers who have similar levels of alcohol use (Lau-Barraco et al., 2012; Reifman et al., 2006). The present research focuses on the aftermath of an alcohol intervention, wherein both selection and socialization may affect intervention efficacy. Selection processes suggest that students who successfully initiate reductions in drinking may do so by spending less time with risky peers; maintaining reduced drinking over time may require permanently moving into a lighter drinking peer group. Our hypotheses primarily drew on socialization processes, which suggest the potential for the attitudes and behaviors of participants' existing peer groups to influence the extent to which they initially reduced and subsequently maintained changes in behavior over time.

The broader alcohol treatment literature also provides support for the influence of social networks on intervention outcomes. Among individuals receiving extended treatment for alcohol abuse, having family members or peers who use alcohol and/or who do not support reducing alcohol use are associated with

decreased likelihood of attaining abstinence (Groh, Jason, & Keys, 2008; Zywiak, Longabaugh, & Wirtz, 2002). For those who do achieve abstinence, peer drinking and peer disapproval of abstinence are associated with increased likelihood of relapse (Chung & Maisto, 2006; Groh et al., 2008; Zywiak et al., 2002). However, family and peer support for abstinence predicts better posttreatment outcomes (Beattie & Longabaugh, 1999; McCrady, 2004).

Examining factors that may moderate intervention efficacy can help to identify which individuals are likely to benefit from an intervention (Kraemer, Wilson, Fairburn, & Agras, 2002). Intuitively, riskier social networks might be expected to be associated with decreased intervention efficacy. However, greater intervention efficacy has been observed among college students with higher levels of baseline risk for alcohol use (Donohue, Allen, Maurer, Ozols, & Destefano, 2004; Dumas, McKinley, & Book, 2009). For example, Donohue et al. (2004) observed that, relative to a computer-delivered intervention, a counselor-delivered intervention was most efficacious among college students with high levels of baseline alcohol consumption. To the extent that social network attributes tend to mirror personal level of drinking, social networks may similarly moderate intervention efficacy. That is, counselor-delivered interventions may be particularly efficacious relative to computer-delivered interventions among individuals with riskier social networks. Efficacy of counselor- versus computer-delivered interventions varies as a function of individual differences at both short-term follow-ups (i.e., 1–3 months; Carey, Henson, Carey, & Maisto, 2009; Donohue et al., 2004; Mastroleo, Murphy, Colby, Monti, & Barnett, 2011) and longer term follow-ups (i.e., beyond 3 months; Monahan et al., 2013). Social network attributes may therefore moderate intervention efficacy in the context of both initiation and maintenance of change.

In sum, research has examined the role of social networks both in naturalistic studies of young adult drinking and in relapse after extended alcohol treatment. These precedents raise the possibility that social networks may affect the process of behavior change among nontreatment-seeking college students. In the present study, we sought to examine the influence of social networks on initiation of behavior change and maintenance of intervention effects over time. To address this question, we conducted a secondary analysis, using data from a published trial (Carey, Carey, Henson, Maisto, & Demartini, 2011) that documented significant postintervention reductions in alcohol use in two conditions—a brief motivational counselor-delivered intervention (BMI) and a brief computer-delivered intervention, Alcohol Edu for Sanctions (EDU). Individuals within one's social network were characterized by perceived level of both alcohol use and support for reducing alcohol use.

Using latent growth models, we examined two phases of intervention response. The initiation phase reflected reductions in alcohol use and consequences by 1 month following the intervention (model intercepts). The maintenance phase reflected the extent of growth in outcomes between 1 and 12 months following the intervention (model slopes). Our primary hypotheses focused on main effects of peers' attitudes and behaviors, as perceived by the participant. Overall, riskier social networks were expected to be associated with smaller initial changes in alcohol use and an accelerated increase in drinking over time, indicating faster return to baseline levels of drinking and decay of intervention efficacy. Our secondary hypotheses tested the moderating role of social networks. Because we expected the counselor-delivered BMI to be

a more efficacious intervention than the computer-delivered EDU, EDU served as the control condition. We expected that, relative to EDU, BMI would be particularly successful in producing initial reductions in alcohol use and in maintaining reductions in alcohol use over time among individuals in riskier social networks.

Method

In the original intervention trial, students who had violated campus alcohol policies were randomly assigned to one of four conditions: (a) a counselor-delivered BMI; (b) a computer-delivered intervention, EDU; (c) a computer-delivered intervention, Alcohol 101 Plus; or (d) a delayed intervention control group. Participants completed a baseline assessment prior to intervention delivery and follow-up assessments 1, 6, and 12 months following intervention completion. The delayed control group received the intervention of their choosing after the 1-month follow-up and did not provide further follow-up data. We did not include the delayed control in the present analyses because of our interest in trajectories over the follow-up period. Further, we did not include Alcohol 101 Plus in the present analyses because of our interest in investigating the role of social networks in empirically supported interventions. Counselor-delivered brief interventions and EDU have demonstrated efficacy in producing at least initial reductions in drinking quantity, but Alcohol 101 Plus has not (Campbell & Hester, 2012; Carey et al., 2011; Carey et al., 2012).

Participants

Participants were college students who received either the BMI or EDU ($N = 331$), and who provided data on the two network variables, covariates, and the three drinking outcomes. Because 15 participants (5%) had missing data on an exogenous variable or at all follow-ups, the final analytic sample included 316 participants. All participants were students at a large private university in the Northeast who had violated campus alcohol policies and were mandated to participate in an alcohol risk reduction intervention. Inclusion in the study required that this was the participant's first alcohol violation on campus, that the offense was not severe enough to warrant referral to Judicial Affairs, and that the participant reported drinking alcohol in the month prior to receiving the sanction. Participants provided written informed consent prior to participation, and study procedures were conducted in compliance with the university's Institutional Review Board.

Interventions

BMI. Trained counselors used data from the baseline assessment coupled with motivational interviewing techniques to review a personalized feedback form with participants. Personalized feedback compared participants' baseline quantity and frequency of alcohol use and perceived descriptive norms with gender-consistent, university-specific norms for alcohol use. Personalized feedback was also given regarding the participant's typical and peak blood alcohol concentration (BAC) and consequences experienced as a result of drinking. Behavioral strategies for reducing alcohol-related risks were discussed, and participants were invited to set goals for risk reduction. The BMI required approximately 1 hr for completion.

EDU. EDU was delivered by computer and consisted of five chapters that provided personalized feedback on drinking and risk for consequences, in addition to content specific to the nature of drinking among mandated students (e.g., blacking out). Unlike the BMI, the program did not provide normative feedback. One month after completing the first four chapters of the program, participants were contacted via e-mail to complete the final chapter of the program, in which alcohol use postintervention was reviewed. In total, the program required approximately 2 hr for completion.

Measures

Demographics. Participants provided information regarding their gender, age, weight, ethnicity, and Greek involvement at baseline.

Alcohol use. Alcohol use was assessed at all time points; a *standard drink* was defined as one 12-ounce bottle of beer, one 5-ounce glass of wine, or 1.5 ounces of distilled spirits (Dufour, 1999). At baseline, participants were asked to think about the week in which they consumed the most alcohol in the month before the event leading to the sanction. At all follow-ups, alcohol use in the last month was assessed. Drinking in the heaviest week in the past month was assessed with a 7-day grid, adapted from the Daily Drinking Questionnaire (R. L. Collins, Parks, & Marlatt, 1985). Responses were summed across the 7 days to reflect the total number of drinks consumed in the heaviest week. Participants also reported the maximum number of drinks consumed in a single day and the number of hours during which they consumed alcohol on this day. Peak BAC on the heaviest drinking day was calculated using a standard formula, accounting for participants' gender and weight (Matthews & Miller, 1979). We focused on heavy drinking outcomes for the present analysis because peers strongly influence heavy drinking episodes (Reifman & Watson, 2003). On the basis of the original intervention trial, we also expected larger intervention effects and greater variability in these outcomes.

Consequences. The Rutgers Alcohol Problems Index (White & Labouvie, 1989) was used to assess negative consequences experienced as a result of alcohol use in the previous 30 days. The scale consists of 23 items (e.g., hangover, missed school or work) rated on a 5-point scale ranging from 0 (*never*) to 4 (*more than 10 times*). Items were averaged to form a scale score. Cronbach's alpha was .84.

Social network attributes. A modified version (i.e., for a young adult, nontreatment-seeking population) of the Brief Important People Interview (BIPI; Clifford & Longabaugh, 1991; Zywiak et al., 2002) was used to characterize social network attributes at baseline. The BIPI was derived from the Important People Interview (IPI; Clifford & Longabaugh, 1991), which was used in Projects MATCH (Project Match Research Group, 1997) and COMBINE (Anton et al., 2006) to assess perceptions of social network support for drinking. The BIPI retains the subset of components from the original interview that best predicted treatment outcomes in COMBINE. The IPI has good test-retest reliability among both treatment-seeking and college student samples (Hallgren, Ladd, & Greenfield, 2013; Longabaugh, Wirtz, Zweben, & Stout, 1998) and detects change in level of network support for drinking among individuals attending Alcoholics Anonymous (Kelly, Stout, Magill, & Tonigan, 2011), suggesting that it captures the objective reality of peer drinking.

Administration of the BIPI followed the manual (Zywiak & Longabaugh, 2002). Participants listed up to 10 friends who were on campus, with whom they had had regular face-to-face contact in the previous 6 months, and who had been the most significant in their lives. We focused on two items that have predicted treatment outcomes in previous research (Kelly et al., 2011; Longabaugh, Wirtz, Zywiak, & O'Malley, 2010; Zywiak et al., 2002) and capture the distinction between peer drinking and peer support for drinking. Participants described each friend's drinking status on a scale ranging from 1 (*recovering alcoholic*) to 6 (*very heavy drinker*). The "very heavy drinker" category was added in the present study to facilitate greater use of the endpoint of the scale. The IPI includes the item, "How has this person reacted to your drinking?" rated from "encouraged" to "left, or made you leave when you were drinking." To capture this sentiment for a college student who has not committed to abstinence, participants rated how accepting each friend would be if the participant "decided to drink much less" than they were at present. Anchors were 1 (*not very accepting*) and 4 (*very accepting*). Scores for peer drinking status and peer acceptability of decreasing use were created by averaging ratings across all nominated friends.

Data Analysis

SPSS 20 was used to examine descriptive statistics for peer drinking status and peer acceptability of decreasing use and to conduct *t* tests to compare men and women on these measures. The original study reported a composite measure of alcohol use that aggregated across a number of outcomes. In the present study, we conducted within-subjects *t* tests and regression analyses to examine within- and between-condition changes in outcomes.

Multiple-group latent growth models were used to examine the influences of peer drinking status and peer acceptability of decreasing use on initiation (model intercepts) and maintenance (model slopes) of behavior change over time. Models were estimated in MPlus 7 (Muthén & Muthén, 1998–2012), with groups reflecting condition (BMI or EDU). Separate models were examined for each outcome. Participants with missing data on any exogenous variable or with missing data on all measures in the growth trajectory were excluded from analyses, resulting in final samples of 314–316 participants, depending on the outcome.

Models were estimated using full information maximum likelihood estimation. Model fit was evaluated using the chi-square (χ^2), comparative fit index (CFI), standardized root-mean-square residual (SRMR), and root-mean-square error of approximation (RMSEA). In path models, CFI values above .95, SRMR values below .08, and RMSEA values below .06 indicate good fit (Hu & Bentler, 1998). The intercept factor had loadings of 1 for all follow-ups; the slope factor was defined by assigning values of 0, 5, and 11 to the 1-, 6-, and 12-month follow-ups. The model intercept therefore reflects mean level of alcohol use and consequences at the 1-month follow-up, capturing the extent of initiation of behavior change; the slope reflects growth in alcohol use and consequences between the 1- and 12-month follow-ups, capturing the extent of maintenance of behavior change. Linear models were estimated with random intercepts for all outcomes.¹ For consequences only, random slopes were included in the final model, and bootstrapping was used to address skew (Enders, 2001). Gender and baseline status on the same outcome were included as cova-

riates. Inclusion of baseline status allows for interpretations of (a) the intercepts and slopes as reflecting change from baseline drinking and (b) the effects of the social network attributes above and beyond participants' own behaviors.

Multiple-group latent growth models were estimated in which we first constrained all variances, residual variances, means, and path coefficients to be equal across conditions. In the second step, we examined whether the variances, residual variances, or intercept or slope means significantly differed between conditions. Each variance or mean was freed individually, providing a one degree-of-freedom chi-square test of whether a significant difference existed between conditions. When significant, the variance or mean was freely estimated across conditions. Third, we accounted for effects of Baseline Status \times Condition interactions on the intercepts and slopes, again by examining one degree-of-freedom df chi-square tests when the effects of baseline status on the intercepts and slopes were constrained versus freely estimated. Fourth, we tested interactions between each social network attribute and condition predicting the intercepts and slopes using the one degree-of-freedom chi-square test. Significant interactions were probed at different levels of the social network attributes by centering the attribute at the mean and one standard deviation above and below the mean (Aiken & West, 1991). When, for example, a significant Social Network \times Condition interaction emerged for a slope, models with the slope constrained versus unconstrained provided a test of the difference between conditions at low, mean, and high values of the social network attribute. Significant interactions were also probed within condition.

Results

Sample Description

Participants were predominantly male (63%), White (86%), and freshmen or sophomores (97%). In all, 12.4% were pledging or members of the Greek system; three participants lived off campus. On average, participants listed 7.45 friends in their social networks ($SD = 1.76$; range = 3–10). The average perceived peer drinking status fell between the categories of light and moderate drinker ($M = 3.77$, $SD = .52$); 21% of peers were classified as heavy or very heavy drinkers. On average, peers were perceived to be "somewhat accepting" to "very accepting" of participants decreasing their alcohol use ($M = 3.52$, $SD = .56$). Peer drinking status and acceptability of decreasing use were negatively correlated ($r = -.28$, $p = .001$); that is, the more a friend was perceived to drink, the less accepting he or she was perceived to be of the respondent decreasing their alcohol use. Correlations between baseline levels on the outcomes and the social network attributes were small to moderate ($r_s = .12-.26$). Men and women did not differ in peer drinking status ($t = 1.22$, $p = .22$), but women's peers were perceived to be more accepting of decreasing alcohol use than were men's peers (M_s 3.69 vs. 3.42, $t = -4.47$, $p = .001$).

Attrition

Of the 316 participants included in our analysis, 2% did not complete the 1-month follow-up, 41% did not complete the 6-month,

¹ Quadratic models were explored but were not significant for either condition on any of the outcomes ($ps \geq .47$).

and 26% did not complete the 12-month follow-up. Attrition was not related to baseline levels of drinking (all $ps > .08$) or demographics ($ps > .15$). Attrition differed by gender (females less than males) at the 12-month follow-up only ($p = .01$).

Intervention Efficacy and Model Fit

As reported in the original trial (Carey et al., 2011), both intervention conditions reduced alcohol consumption and consequences at the 1-month follow-up ($ps < .05$), suggesting overall efficacy for producing initial changes in consumption and consequences. At 1 month, the BMI was associated with greater reductions in the consumption variables ($ps < .05$) but not consequences. With respect to growth between the 1- and 12-month follow-ups, participants in both conditions significantly increased in consumption and consequences over time ($ps < .01$). The rate of growth marginally differed between conditions only for drinks per heaviest week ($t = -1.78, p = .08$).

Final models indicated adequate to good fit to the data (see Table 1). There were significant Baseline Status \times Condition interactions for initiation and maintenance of reductions in both drinks per heaviest week and consequences and for initiation of reductions in peak BAC. Overall, effects of the BMI relative to EDU were stronger for those high in consumption and consequences, and baseline status was related to growth in outcomes among EDU but not BMI participants. The moderating role of baseline status was controlled for in subsequent analyses examining the social network attributes by allowing paths from baseline status to the intercepts and slopes to be freely estimated across conditions. This permits interpretation of results as the effects of social networks independent of moderation by baseline status.

Main Effects of Social Networks on Initiation and Maintenance

Initiation. We hypothesized main effects of peer drinking status and peer acceptability on the growth model intercepts, reflecting the extent to which participants initiated reductions in drinking and consequences at 1 month. Consistent with hypotheses, peer drinking status was positively associated with initiation of reductions in drinks per heaviest week ($B = 2.07, t = 1.94, p = .05$) and peak BAC ($B = .02, t = 3.40, p = .01$), suggesting that, across both conditions, participants who perceived their social networks as heavier drinking had smaller reductions in drinks per heaviest week and peak BAC at 1 month. Peer acceptability of decreasing use predicted initiation of reductions in consequences ($B = -1.22, t = -2.04, p = .04$). MPlus (Muthén & Muthén, 1998–2012) generates an effect size estimate that expresses the

magnitude of change in Y, expressed in standard deviation units, for a one standard deviation change in X. Effect sizes for the influences of peer drinking status and peer acceptability on initiation were small (Cohen, 1992). A one standard deviation increase in peer drinking status was associated with a .13 standard deviation increase in drinks per heaviest week and a .18 standard deviation increase in peak BAC. A one standard deviation decrease in peer acceptability was associated with a .19 standard deviation increase in consequences at 1 month. Contrary to hypotheses, peer drinking status was not associated with consequences, and peer acceptability was unrelated to either consumption outcome 1 month following the interventions.

Maintenance. We also hypothesized main effects of peer drinking status and peer acceptability on the model slopes for growth in alcohol use and consequences over the follow-up, reflecting lack of maintenance of intervention effects. In contrast to expectations, there were no main effects of either peer drinking status or peer acceptability of decreasing use on maintenance (all $ps > .19$).

Social Network \times Condition Interactions

Initiation. We hypothesized interactions between condition and the social network attributes predicting both initiation of reduced drinking at 1 month (model intercepts) and maintenance of reduced drinking over time (model slopes). The BMI was expected to be most efficacious in reducing and maintaining lower levels of outcomes among individuals in the riskiest networks. Contrary to hypotheses, neither social network attribute significantly interacted with condition in predicting initiation of reductions in drinking or consequences.

Maintenance. Peer drinking status did not interact with condition to predict growth in any of the outcomes (all $ps > .11$). However, consistent with our hypotheses for interactions, peer acceptability of decreasing use interacted with condition to predict growth in the outcomes. The interaction was marginal for growth in drinks per heaviest week, $\chi^2\Delta(1) = 2.98, p = .08$, but was significant for growth in peak BAC, $\chi^2\Delta(1) = 4.32, p = .04$, and growth in consequences, $\chi^2\Delta(1) = 5.32, p = .02$. We probed the marginal interaction for drinks per heaviest week to demonstrate consistency of the effects.

Table 2 displays the tests of whether the BMI and EDU slopes were significantly different from one another and the within-condition slopes at low, mean, and high values of peer acceptability. For drinks per heaviest week, BMI and EDU participants did not differ in rate of growth when they were in low-risk networks, that is, peers who were perceived to be accepting of decreasing use. However, in networks at the mean or low in peer acceptability, BMI and EDU participants significantly differed in rate of growth

Table 1
Fit Statistics for Final Models

Outcome	χ^2	CFI	SRMR	RMSEA
Drinks per heaviest week	$\chi^2(19) = 29.60, p = .06$.98	.04	0.06 (CI [0.00, 0.10])
Peak BAC	$\chi^2(26) = 25.03, p = .52$	1.00	.06	0.00 (CI [0.00, 0.06])
Consequences	$\chi^2(25) = 41.79, p = .02$.94	.05	0.07 (CI [0.03, 0.10])

Note. CFI = comparative fit index; SRMR = standardized root-mean-square residual; RMSEA = root-mean-square error of approximation; BAC = blood alcohol concentration.

Table 2
Simple Slopes for Peer Acceptability × Condition Interactions

Outcome	Level of peer acceptability	Test of difference between BMI and EDU slopes	Unstandardized slope in BMI	Unstandardized slope in EDU
Drinks per heaviest week	Low	$\chi^2 = 7.72, p = .01$	0.37	0.87
	Mean	$\chi^2 = 4.97, p = .03$	0.37	0.67
	High	$\chi^2 = 0.26, p = .66$	0.38	0.46
Peak BAC	Low	$\chi^2 = 2.66, p = .10$	0.002	0.003
	Mean	$\chi^2 = 0.11, p = .74$	0.002	0.002
	High	$\chi^2 = 1.34, p = .25$	0.002	0.001 ^a
Consequences	Low	$\chi^2 = 5.13, p = .02$	0.01 ^a	0.19
	Mean	$\chi^2 = 1.12, p = .29$	0.09	0.14
	High	$\chi^2 = 1.18, p = .28$	0.18	0.09 ^a

Note. BMI = brief motivational counselor-delivered intervention; EDU = Alcohol Edu for Sanctions; BAC = blood alcohol concentration.
^a Denotes nonsignificant slope; all other slopes significantly different from zero. Simple slopes at mean, low, and high levels of peer acceptability were probed at the mean and at one standard deviation below and above the mean, respectively.

in drinks per heaviest week ($ps < .05$). Similarly, rates of growth in peak BAC did not differ at high or mean levels of peer acceptability but were marginally different when networks were low in peer acceptability ($p = .10$; see Figure 1). The interaction yielded a similar pattern of results for consequences. BMI and EDU participants significantly differed in rate of growth in consequences only when they were in networks that were perceived as low in peer acceptability ($p = .02$). Taken together, EDU participants in networks that were perceived as low in peer acceptability generally exhibited the fastest rate of decay of intervention effects, increasing in drinks per heaviest week by .89 drinks per month, peak BAC by .003 units per month, and consequences by .19 per month. In contrast, BMI participants in networks that were perceived as low in peer acceptability increased at more moderate rates. They increased in drinks per heaviest week by .37 drinks per month, peak BAC by .002 units per month, and did not significantly increase in consequences over time (.01 consequences per month).

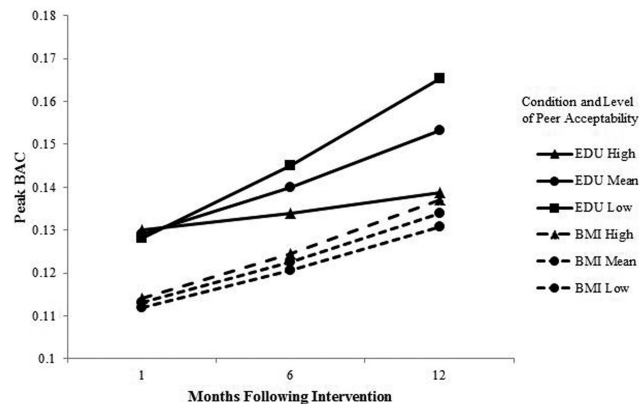


Figure 1. Simple slopes for condition by peer acceptability of reducing use interaction predicting peak BAC. Simple slopes were probed at the mean and at one standard deviation above (high) and below (low) the mean of peer acceptability. BAC = blood alcohol concentration; EDU = Alcohol Edu for Sanctions; BMI = brief motivational counselor-delivered intervention.

We also probed the Peer Acceptability × Condition interactions within condition. Peer acceptability was consistently unrelated to growth in alcohol use and consequences among BMI participants (drinks per heaviest week: $B = -0.02, t = -0.12, p = .90$; peak BAC: $B = 0.000, t = 0.31, p = .78$; consequences: $B = 0.15, t = 1.56, p = .12$). However, among EDU participants, being in a social network that was perceived to be less accepting of reducing drinking predicted steeper growth in alcohol use but not consequences over time (drinks per heaviest week: $B = -0.39, t = -2.26, p = .02$; peak BAC: $B = -0.002, t = -2.33, p = .02$; consequences: $B = -0.08, t = -0.91, p = .37$). The clustering of slopes at different levels of peer acceptability among BMI participants versus differentiation of slopes in EDU can be seen in Figure 1.²

Effect sizes reflected the differential relationships of the social network attributes to outcomes among EDU and BMI participants. Among EDU participants, a one standard deviation decrease in peer acceptability of decreasing use was associated with a .44 standard deviation increase in the rate of growth in drinks per heaviest week, a .90 standard deviation increase in the rate of growth in peak BAC, and a .18 standard deviation increase in the rate of growth in consequences. Among BMI recipients, the effects were nonsignificant across all outcomes and in the opposite direction for peak BAC and consequences: A one standard deviation decrease in peer acceptability was associated with a .04 standard deviation increase in growth in drinks per heaviest week, a .37 standard deviation decrease in growth in peak BAC, and a .41 standard deviation decrease in growth in consequences. These effect sizes suggest small to moderate effects of perceived peer acceptability among BMI participants but larger effects among EDU participants, particularly for the consumption outcomes.

Discussion

Alcohol risk reduction interventions for college students typically show initial, short-term reductions in drinking that decay with time. In the present research, we aimed to contribute to this literature by examining the role of college students' social net-

² Results generally reflected the same pattern of effects for typical drinks per week and typical BAC.

works in facilitating or hindering behavior change following two brief interventions. Notably, influences of peer social networks, as perceived by the participant, emerged over and above not only main effects of baseline level of drinking but also Baseline Drinking \times Condition interactions. Main effects of students' social networks on initiation of behavior change were observed in three out of six tests. Peer drinking status had small effects on initial reductions in both consumption variables, whereas peer acceptability predicted initial reductions in consequences. When considering maintenance of behavior change over time, interactions between intervention condition and peer acceptability were significant for peak BAC and consequences and marginal for drinks per heaviest week. The BMI was particularly effective in maintaining reductions, relative to EDU, when participants were in riskier networks. Although there were no main effects of social networks on maintenance, riskier social networks were strongly associated with steeper growth in the consumption outcomes over time (i.e., faster return to baseline drinking levels) among EDU participants, but were unrelated to growth among BMI participants. Overall, results suggest that individuals in riskier social networks may be less likely to initiate reductions in drinking, regardless of the type of intervention they receive. However, how well students maintain changes over time reflects the interplay of their social networks with the content and type of intervention received.

The observed influence of social networks on initiation and on growth in alcohol use over the follow-up period is consistent with both theoretical models suggesting an influence of peers on health behaviors (e.g., Bandura, 1998; Bronfenbrenner, 1979) and with models of intervention efficacy that view networks as resources that can facilitate or hinder behavior change (Johnson et al., 2010). Previous research has examined individual-level predictors and moderators of drinking outcomes following brief interventions, including the pros and cons of drinking, self-regulation, and the relative reinforcing value of alcohol (S. E. Collins & Carey, 2005; Curtin, Stephens, & Bonenberger, 2001; Murphy, Correia, Colby, & Vuchinich, 2005). To the extent that perceptions of peer behavior and attitudes reflect the real circumstances that college students must navigate while attempting risk reduction, results highlight the importance of understanding whether and how factors external to the individual affect postintervention outcomes.

Our results, with social networks affecting maintenance of reductions in consumption in EDU but not BMI, corroborate recent meta-analytic research indicating that the effects of computer-delivered alcohol interventions decay rapidly (potentially as a result of social network effects in such contexts), whereas effects of counselor-delivered interventions are more enduring (Carey et al., 2012). Nonetheless, social networks might similarly affect counselor-delivered interventions that contain different active ingredients than the present BMI. The inclusion of normative feedback in the BMI but not EDU may account for stronger effects of social networks on maintenance in EDU. To the extent that individuals who receive a BMI change their perceptions of not only the campus drinking norms but also their peer groups' norms (Carey, Henson, Carey, & Maisto, 2010), providing normative feedback may be sufficient for mitigating effects of peers on maintenance. However, BMIs have been shown to mitigate the influence of the tendency to compare oneself with others on alcohol use (Carey, Henson, Carey, & Maisto, 2007), and social comparison has been proposed as a mechanism of social network influence (Berkman,

Glass, Brisette, & Seeman, 2000). The lesser influence of social networks in the BMI may reflect that BMIs decrease the tendency to engage in social comparison while drinking, which may be an outcome of challenging perceived norms.

Colleges and universities are required to provide interventions to students who violate campus alcohol policies. As limited resources (i.e., staff) often preclude providing counselor-delivered interventions to all mandated students, our results are consistent with previous research suggesting that counselor-delivered interventions should be targeted toward the riskiest students (Mun, White, & Morgan, 2009), for whom such interventions are likely to be most effective. An initial screener assessing students' perceptions of the level of risk associated with their social networks might assist in triaging students in low-risk networks to a computer-delivered intervention, while reserving the more resource intensive, counselor-delivered interventions for students in riskier networks.

Students with peers perceived as heavier drinking reported smaller reductions in both drinks per heaviest week and peak BAC at 1-month follow-up. Conversely, peer acceptability related to initiation of reductions in consequences and predicted how well EDU participants maintained reductions in consumption over time. Previous research has demonstrated that descriptive norms (how most others behave) predict behavior assessed more proximally, whereas injunctive norms (what is approved of by most others) relate more strongly to distal outcomes (Larimer, Turner, Mallett, & Geisner, 2004). Taken together with the present findings, peer behavior and peer attitudes may exert influence at different points in the behavior change process. Results also suggest that targeting perceived peer attitudes in interventions may fruitfully enhance maintenance of behavior change. However, on average, participants already described their friends as somewhat to very accepting of reducing drinking, suggesting that peer acceptability may not be a strong target for normative feedback interventions for the typical student. Rather, active ingredients that provide students with skills for negotiating moderate drinking with less approving peers may successfully mitigate this influence on maintenance.

Our findings should be interpreted in light of the study limitations. First, results may not generalize to students who are not mandated to receive an intervention as a result of violating campus alcohol policies. Second, data were collected at a university with few commuters and relatively little Greek involvement, limiting our ability to test these potential moderators. Influences of social networks on drinking may be weaker on campuses with more commuters and/or particularly strong among students involved in the Greek system. Third, our sample was composed primarily of underclassmen. However, as upperclassmen are likely to have more stable social networks, we might expect stronger influences of preintervention social networks on their outcomes. Fourth, our measure of peer acceptability of decreasing use evidenced restriction of range, potentially reducing power. Finally, we used self-report measures of alcohol use and social network attributes. However, these correspond well with collateral and objective measurements of alcohol use (Borsari & Muellerleile, 2009; Carey & Hustad, 2002) and with friends' own reports (Valente, Fujimoto, Soto, Ritt-Olson, & Unger, 2013).

In sum, the alcohol treatment relapse and recovery literatures provide evidence for the influence of the social environment on initiation and maintenance of behavior change following interventions (Moos, 2007; Witkiewitz & Marlatt, 2004). This study represents an initial effort toward considering the role of social networks in initia-

tion and maintenance of reductions in alcohol use following intervention among college students. Given the strong influences of perceived peer behavior and attitudes, particularly on maintenance of reductions in alcohol use among those who received the computer-delivered program, further understanding how and under what circumstances college students' social networks affect the behavior change process is a crucial step toward the development of more effective, longer lasting interventions.

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