Targeting Misperceptions of Descriptive Drinking Norms: Efficacy of a Computer-Delivered Personalized Normative Feedback Intervention

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The authors evaluated the efficacy of a computer-delivered personalized normative feedback intervention in reducing alcohol consumption among heavy-drinking college students. Participants included 252 students who were randomly assigned to an intervention or control group following a baseline assessment. Immediately after completing measures of reasons for drinking, perceived norms, and drinking behavior, participants in the intervention condition were provided with computerized information detailing their own drinking behavior, their perceptions of typical student drinking, and actual typical student drinking. Results indicated that normative feedback was effective in changing perceived norms and alcohol consumption at 3- and 6-month follow-up assessments. In addition, the intervention was somewhat more effective at 3-month follow-up among participants who drank more for social reasons.

Social norms approaches to prevention of high-risk drinking are being increasingly implemented on college campuses. One of these approaches involves providing heavy-drinking students with personalized normative feedback designed to correct misperceptions of descriptive drinking norms. Despite the fact that this approach is frequently included as one component in multicomponent interventions, no research to date has uniquely documented its efficacy in changing perceived norms or reducing alcohol consumption. The present research was designed to evaluate personalized normative feedback as a stand-alone intervention for reducing alcohol consumption among heavy-drinking college students. We sought to evaluate the impact of personalized normative feedback on perceived norms and alcohol consumption at 3 and 6 months postbaseline and to examine social reasons for drinking as a potential moderator of intervention efficacy.

Social Norms Interventions

One strategy that has shown considerable promise in addressing heavy drinking among college students involves changing perceived drinking norms. Peer drinking norms have been found to have a larger influence on personal drinking behavior of college students compared with the influence of parents, resident advisers, and faculty (Perkins, 2002). Several studies have shown that college students have distorted perceptions of typical drinking among their peers (Baer, Stacy, & Larimer, 1991; Perkins & Berkowitz, 1986; Perkins & Wechsler, 1996; Prentice & Miller, 1993). The degree of misperception is influenced by several factors, including type of norm (injunctive or descriptive), gender, reference group, question specificity, and size of campus, but the direction of misperception is consistent (Borsari & Carey, 2003). College students tend to overestimate the prevalence of heavy alcohol consumption among their peers (Perkins & Berkowitz, 1986; Perkins & Wechsler, 1996). This misperception has been suggested as a causal factor in perpetuating heavy drinking among college students. Correcting this misperception has been the key focus of many recent intervention studies (Agostinelli, Brown, & Miller, 1995; Fabiano, McKinney, Hyun, Mertz, & Rhoads, 1999; Haines & Spear, 1996; Nye, Agostinelli, & Smith, 1999; Walters, 2000) and has been incorporated in several other studies as one intervention component (Baer et al., 1992; Borsari & Carey, 2000; Larimer et al., 2001; Marlatt et al., 1998; Murphy et al., 2001).

Influence of Perceived Drinking Norms on Alcohol Consumption

Social norms refer to two distinct categories of perceptions (Cialdini, Reno, & Kallgren, 1990). Injunctive norms refer to perceptions of the extent to which others approve or disapprove of a given behavior and carry an implicit tone of evaluation regarding the "rightness" or "wrongness" of a behavior. In contrast, descriptive norms refer to perceptions of what others actually do (e.g., how much the average college student drinks). In this research, we focused exclusively on descriptive norms. According to Borsari and Carey (2001), perceived norms influence a person's alcohol consumption by a two-step process. The first step involves the comparison of personal alcohol consumption to the perceived norms. The second step involves the application of exaggerated

norms as a standard for one's own behaviors. It has been well documented that, in general, students overestimate the drinking of their peers. If drinking is affected by perceptions of peer drinking, then presenting heavy-drinking students with information indicating that their perceptions are out of line with reality, especially if done in a nonthreatening way (see Nye et al., 1999), may be sufficient to develop a discrepancy between one's values and one's behaviors (Miller & Rollnick, 2002). S. E. Collins, Carey, and Sliwinski (2002) suggested that personalized normative feedback develops discrepancy by making student's drinking behaviors salient, by providing them a context in which to evaluate their drinking, and by highlighting the inconsistency between current behavior and both normative and personal standards.

Social Marketing

Social norms interventions have typically come in one of two forms: social marketing or individual feedback. Social marketing approaches rely on media advertisements, flyers, posters and other universal, mass communication methods for educating students regarding actual drinking behaviors. Although social marketing approaches have the advantage of reaching a larger audience at low cost, they are limited by being relatively impersonal and assuming that students will both see and carefully process the information.

Personalized Normative Feedback

In contrast to social marketing interventions, normative feedback that is personalized and presented individually is likely to have a greater impact because it is more salient (Cialdini, Reno, & Kallgren, 1990; Kallgren, Reno, & Cialdini, 2000) and explicit in revealing discrepancies between individual behavior, perceived typical student behavior, and actual typical student behavior. Some evidence for the effectiveness of personalized normative feedback can be deduced from the efficacy of brief interventions such as the Brief Alcohol Screening and Intervention for College Students (BASICS; Dimeff, Baer, Kivlahan, & Marlatt, 1999) in which personalized feedback is offered using motivational interviewing techniques (Miller & Rollnick, 2002). This personalized feedback typically includes information about actual drinking norms, as well as a comparison between the student's drinking pattern and the actual college norm (Baer et al., 1992; Borsari & Carey, 2000; Dimeff et al., 1999; Larimer et al., 2001; Marlatt et al., 1998). This kind of personalized feedback has been effective, even when delivered by mail (Agostinelli et al., 1995; S. E. Collins et al., 2002; Cunningham, Wild, Bondy, & Lin, 2001; Walters, 2000; Walters, Gruenewald, Miller, & Bennett, 2001), and there is some evidence suggesting that normative information alone may be effective in reducing heavy drinking provided that it is delivered in a nonthreatening manner (Nye et al., 1999). The Internet has also been evaluated as a possible mode for personalized feedback interventions (Cunningham, Humphreys, & Koski-Jannes, 2000). Computerized normative feedback has also been found to generate more interest as a form of help among younger drinkers compared with older drinkers (Koski-Jannes & Cunningham, 2001).

Although these studies generally support personalized normative feedback as an intervention strategy, one of the methodological problems associated with existing brief intervention research is that the inclusion of multiple components often prohibits eval-

uation of unique components. Individual components included in brief interventions have not been well examined despite the fact that there are obvious practical and theoretical reasons for doing so (Zweben & Fleming, 1999). Even studies that have purported to evaluate personalized normative feedback have almost invariably included one or more other intervention components (e.g., review of risk factors such as family history, review of negative consequences, expectancy challenge, and Blood Alcohol Content [BAC] information). Only one study, based on our review of the literature, has provided evidence for the effectiveness of normative feedback without confounding other intervention components (Nye et al., 1999). Although this study did not confound intervention components, outcomes were measured immediately after presenting normative feedback and therefore did not examine actual changes in behavior.

Social Reasons for Drinking: Social Expectancies and Motives

Understanding why college students drink is an important question in its own right and has been evaluated using different approaches, all of which conclude that drinking is often motivated by social factors. One approach has examined alcohol outcome expectancies (Leigh, 1989; Neighbors, Walker, & Larimer, 2003; Stacy, Widaman, & Marlatt, 1990). Expectancy approaches examine the extent to which students believe that alcohol has particular effects (e.g., sociability, tension reduction, courage, sexuality, risk and aggression, impairment, and negative self-perceptions) and subjective evaluations associated with those effects (Fromme, Stroot, & Kaplan, 1993). From this perspective, social reasons for drinking are manifested by the belief that drinking alcohol will result in social effects (e.g., cause one to be more outgoing, more friendly, more sociable) and the evaluation of these outcomes as desirable. Another approach is the assessment of drinking motives (Cooper, 1994), which involves directly asking people the extent to which they drink for particular reasons (Cooper, 1994; MacLean & Lecci, 2000; Neighbors, Larimer, Geisner, & Knee, in press; Stewart & Devine, 2000). Social motives assess the extent to which people drink to be sociable and to enhance social functioning. In our view, social expectancies, evaluations, and motives are all aspects of the same global construct that we henceforth refer to as social reasons for drinking.

An implicit but often unrealized goal in studying etiology is that it will inform intervention efforts. Expectancy research, for example, has evolved into successful interventions designed to challenge students' (frequently incorrect) expectations regarding alcohol's effects (Darkes & Goldman, 1993, 1998). Ideally, knowing why college students drink should not only inform the types of interventions we develop, but also enable us to identify the best (and worst) candidates for particular types of interventions. Prior research has identified moderators of social norms interventions (Murphy et al., 2001; Werch et al., 2000). For example, Murphy et al. (2001) demonstrated that an intervention including a social norms component was more effective among heavier drinking college students. In regard to the current research, we suggest normative feedback should have the greatest impact on students who drink largely for social reasons. The fundamental assumption behind normative feedback interventions is that students care about how they compare with their peers. We suggest that students who drink primarily for social reasons are likely to be the students

who care most about how they compare with their peers. Thus, students who drink primarily for social reasons should be more affected by information that suggests that their drinking behavior is not in line with social norms. In contrast, students who do not drink for social reasons should be less concerned about how their drinking compares with their peers and should be less affected by corrective normative feedback.

Method

Participants

Screening. Participants were screened from a sample of 1,115 students (59% were women) from psychology classes at a large northwestern university who were selected based on peak number of drinks reported on one occasion in the previous month. Screening consisted of a very brief questionnaire administered in mass testing that assessed demographics, peak drinking in the previous month, potential interest in the study, and contact information for those who expressed interest (phone number[s] and best times to call). The screening sample consisted primarily of freshmen (79.3%). Ethnic representation of the screening sample (61.0% Caucasian, 29.6% Asian–Asian American, and 9.4% chose the option "other") was relatively consistent with the campus population, which was approximately 69% Caucasian, 23% Asian–Asian American, and 8% other in the year 2001.

Students who indicated at least one heavy drinking episode (5–4 drinks at one sitting for men and women, respectively) in the previous month were eligible to participate. Similar criteria have been used to identify high-risk samples in previous intervention studies (e.g., Marlatt et al., 1998). The 5–4 drinks measure, although somewhat arbitrary, has been used extensively as an indicator of risk in the college drinking literature (Wechsler & Nelson, 2001).

Of the 1,115 participants, 803 (72.0%) expressed interest in participating in the study and 481 (43.3%) met heavy-drinking criteria. Among the 481 heavy drinkers, 379 (79%) indicated interest in participating in the study and provided contact information. Heavy drinkers who expressed interest did not differ from those who indicated no interest in participation in peak number of drinks reported, $t(479) = 1.55$, *ns*. Attempts were made to recruit each of these individuals by phone within a 4-week time period. Two hundred fifty-two (66%) heavy drinkers were successfully recruited and participated in the study. Most of those who did not participate either declined once contacted or were scheduled but did not show-up. Among students who met screening criteria and who expressed interest in participation, actual participants did not differ from nonparticipants in peak number of drinks reported, $t(377) = 1.76$, *ns*.

Participants included 252 (104 men and 148 women) heavy-drinking students at baseline. The average age of participants was 18.5 years ($SD = 1.24$). Ethnicity was 79.5% Caucasian, 13.7% Asian–Asian American, and 6.8% other. Participants received extra course credit for completing the baseline assessment, $15 at 3-month follow-up, and $25 at 6-month follow-up.

Missing data. Missing data were primarily due to attrition. Multiple attempts were made to contact all participants for follow-up sessions. Despite repeated efforts we were unable to reach some participants for one or both follow-up assessments. In addition, some individuals were contacted and scheduled but did not show up. Repeated attempts were made to schedule and reschedule all participants for both follow-up assessments.

Two hundred fifty-two participants completed the baseline assessment. The 3-month follow-up assessment was completed by 198 (79%) participants. The 6-month follow-up was completed by 207 (82%) participants. Twenty-four participants (10%) did not return for either follow-up assessment. A dichotomous "missingness" variable was created, distinguishing participants with complete data from participants who did not complete one or both follow-up assessments. Missingness was regressed on all baseline measures of drinking, perceived norms, reasons for drinking, and interven-

tion conditions using logistic regression. Results indicate that, overall, baseline measures were not significantly associated with missingness, $R^2 = .076$, Wald $\chi^2(11, N = 252) = 17.59$, *ns*. Tests of the individual regression coefficients revealed that missingness was positively associated with perceived norms for drinking frequency ($p = .04$) and negatively associated with alcohol-related problems at baseline ($p = .04$).

Missing data were handled using a maximum likelihood approach, which uses full information to estimate means, variances, and covariances based on observed data. Schafer and Graham (2002) provided a strong endorsement for this approach in their review of state-of-the-art procedures for treatment of missing data. This approach has been shown to be generally superior to older, more traditional treatments of missing data, such as mean imputation and pairwise or listwise deletion, and has been found to result in less bias than other techniques, even when data are not missing at random (Wothke, 2000).

Procedure

The procedure included baseline assessment, intervention, 3-month follow-up, and 6-month follow-up. Participants were contacted by phone and scheduled for assessments. Baseline assessments were scheduled approximately 2–3 weeks after the screening. All assessments took place in a controlled setting on campus. After providing informed consent, individuals completed the baseline assessment on a computer. Assessment included measures of perceived drinking norms and drinking behavior, as well as social motives, expectancies, and evaluations of the social effects of alcohol. Individuals were randomly assigned to the intervention ($n = 126$; 76 women, 50 men) or control group ($n = 126$; 72 women, 54 men). Immediately following the baseline assessment, individuals in the intervention group received personalized normative feedback that was delivered by computer. Participants from both groups were thanked for their participation and were asked to schedule a tentative appointment for the 3-month follow-up. The procedures for 3- and 6-month follow-ups were similar with the exception that no feedback was provided at follow-up assessment. All procedures were reviewed and approved by the local Human Subjects Review Board (HSRB).

Personalized normative feedback. In the intervention condition, participants received personalized normative feedback immediately following the completion of baseline assessment. Participants viewed the feedback on screen for approximately 1 min as it was being printed. Participants were given the printout of this information to take with them. There was no interpersonal interaction involved in the feedback intervention. The format of personalized normative feedback was modeled after the normative feedback component of the BASICS intervention (Dimeff et al., 1999). Consistent with normative feedback that has been used in previous research (Agostinelli et al., 1995; Baer et al., 1992; Borsari & Carey, 2000; Larimer et al., 2001; Marlatt et al., 1998; Murphy et al., 2001; Walters, 2000), this feedback included a summary of the participant's perceived drinking norms compared with actual drinking norms and a summary of students' reported consumption compared with average college drinking behavior. In addition, consistent with previous brief interventions, participants' percentile ranking, comparing their drinking with other college students drinking, was provided. Actual norms were based on data collected on the same campus in the previous year from a large sample of randomly selected undergraduate students participating in the Motivating Campus Change (MC[2]) project. A copy of sample feedback is provided in the Appendix. In sum, feedback was designed to communicate three things: (a) "This is how much you drink," (b) "This is how much you think the typical student drinks," and (c) "This is how much the typical student actually drinks." Unlike other interventions purporting to evaluate normative feedback, no other components were included.

Measures

Perceived norms. Perceived norms were measured by a modified version of the Drinking Norms Rating Form (DNRF; Baer et al., 1991).

Participants were asked to estimate the quantity of alcohol consumed each day of the week by a typical student and by their best friend. Participants were also asked to estimate the number of drinks consumed by the typical student on a given occasion. Perceived norms were operationalized as a latent variable with three indicators consisting of single item measures assessing (a) perceived number of drinks consumed per week by the typical student (PNWEEK), (b) perceived frequency of consumption (per week) by the typical student (PNFREQ), and (c) perceived number of drinks consumed per occasion by the typical student (PNOCC).

Drinking behavior. Drinking behavior was measured as a latent variable consisting of measures of overall consumption, peak quantity, typical weekly drinking, and alcohol-related problems. The Alcohol Consumption Index (ACI; Knee & Neighbors, 2002) consists of eight 7-point Likert-type items ranging from 0 (*zero*) to 6 (*more*). Four items assess the number of occasions the participant consumed five or more drinks at one sitting in various time periods. Four items assess number of drinks consumed in a given time frame (e.g., "On average, how many drinks do you consume on weekends (Friday–Sunday?"). The ACI is scored by taking the mean of all items with possible scores ranging from 0 to 6. Alphas in this study were .94, .94, and .95 at baseline, 3-month follow-up, and 6-month follow-up, respectively. Peak quantity (PEAK) was assessed by an item asking the participants to indicate the number of drinks (0–25 or more) consumed on the occasion in which they drank the most in the previous month (Marlatt et al., 1998). Typical weekly drinking (WEEK) was assessed with the Daily Drinking Questionnaire (DDQ; R. L. Collins, Parks, & Marlatt, 1985), in which participants record the average number of standard drinks consumed and the time period of consumption for each day of the week over the previous 3 months. Scores represent the average number of drinks consumed each week over the previous 3 months. Alcohol-related problems were assessed by a modified version of the Rutgers Alcohol Problems Index (RAPI; White & Labouvie, 1989), which asked participants how often they had experienced 25 alcohol-related consequences (e.g., "Was told by a friend or neighbor to stop or cut down drinking") over the previous 3 months. Item responses ranged from 0 (*never*) to 4 (*more than 10 times*). The RAPI was scored by taking the sum of all items with possible scores ranging from 0 to 100. Alphas in this study were .85, .82, and .89 at baseline, 3-month follow-up and 6-month follow-up, respectively.

Social reasons for drinking. Social reasons for drinking were measured as a latent variable consisting of three indicators. The Social Rewards subscale of the Drinking Motives Questionnaire (DMSOC; Cooper, 1994) includes five Likert-type items ($\alpha = .91$) that ask participants how often they are motivated to drink for positive social outcomes (e.g., "to be sociable"). Responses range from 1 (*never–almost never*) to 5 (*always–almost always*). Scores represent the mean of the items with possible scores ranging from 1 to 5. Social outcome expectancies (EXSOC) and subjective evaluations of social effects of alcohol (EVSOC) were measured using the Sociability subscales of the Comprehensive Effects of Alcohol Scale (Fromme et al., 1993). Expectancies were assessed by asking participants the extent to which they believe being under the influence of alcohol has particular effects (e.g., "I would be more sociable"; $\alpha = .76$). Responses ranged from 1 (*disagree*) to 4 (*agree*). Scores were computed as the mean of the items with possible scores ranging from 1 to 4. Subjective evaluations were assessed by asking participants to rate each potential effect of alcohol from -2 (*bad*) to 2 (*good*). Scores were calculated as the mean of the items ($\alpha = .77$), with possible scores ranging from -2 to 2.

Results

Analysis Strategy

Primary data analysis consisted of structural equation modeling (SEM) with full information maximum likelihood (FIML) using AMOS 4.0 (Arbuckle & Wothke, 1999). This approach was chosen over other approaches for two key reasons. First, each of the central constructs in our data (drinking, perceived norms, and social reasons for drinking) was assessed with multiple indicators, making SEM a logical choice for analytic strategy. Second, this approach incorporates a state-of-the-art method for treatment of missing data (Schafer & Graham, 2002) as described above. Variable distributions were examined for univariate and multivariate nonnormality. Although several variables exhibited some departure from normality, none of these departures were extreme, as defined in the SEM literature (Kline, 1998; West, Finch, & Curran, 1995).

Model fit was evaluated using the normed fit index (NFI; Bentler & Bonett, 1980), the comparative fit index (CFI; Bentler, 1990), and the root-mean-square-error of approximation (RMSEA; Browne & Cudeck, 1993). Values above .90 on the NFI and the CFI indicated good fit. RMSEA values below .05 indicated close fit, values around .08 indicated reasonable fit, and values above .10 indicated poor fit (Browne & Cudeck, 1993). Chi-square was also reported but is considered more useful as a means of comparing nested models than as an absolute indicator of model fit. Effect sizes for intervention effects were calculated using the formula $d = 2t/\sqrt{df}$ (Rosenthal & Rosnow, 1991), where t was approximated by the ratio of unstandardized parameter estimates to their estimated standard errors. Effects sizes in the .2 range are generally considered small, those in the .5 range are considered medium, and those in the .8 range are considered large (Cohen, 1992).

The analysis strategy was as follows. First, we tested a measurement model to evaluate factor structure for proposed latent constructs. Second, we evaluated the impact of normative feedback on drinking behavior at 3- and 6-month follow-ups. Third, we evaluated the impact of normative feedback on perceived norms at 3- and 6-month follow-ups. Fourth, we examined changes in perceived norms at 3 months as a mediator of the effect of normative feedback on drinking reductions at 6 months. Fifth and finally, we evaluated social reasons for drinking as a moderator of the effect of normative feedback on drinking reductions. Additional analyses revealed that gender did not in any way moderate the effects of normative feedback.[1]

Measurement Model

Confirmatory factor analysis (CFA) was conducted separately for control and feedback participants to evaluate factor structure for the seven latent constructs (social reasons for drinking, baseline, 3-month, and 6-month perceived norms, and baseline, 3-month, and 6-month drinking behavior) using FIML. The CFA

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[1] Analyses examining gender differences were undertaken to determine whether normative feedback had similar effects on men and women. Mean differences for perceived norms and drinking behavior were consistent with previous research showing that men drink more and perceive their peers to drink more. However, multigroup SEMs indicated that the effect of normative feedback on drinking did not differ between men and women at 3 or 6 months. Similarly, the effect of normative feedback on perceived drinking norms did not differ between men and women at 3 or 6 months. In addition, the relationship between social reasons for drinking and follow-up drinking did not differ between men and women in the intervention or control group. Because gender was not of theoretical interest in the present study, had no relation to the effects of normative feedback, and did not moderate the predicted interaction between social reasons for drinking and intervention efficacy, it was not considered further. Thus, all results are reported collapsing men and women into a single group. Inquiries regarding main effects for gender on drinking behavior may be addressed to Clayton Neighbors.

demonstrated good fit according to global fit indices, and all of the factor loadings were significant. Improved fit was obtained by allowing measurement errors for the same indicators (PNFEQ, PNTYP, and all four indicators of drinking) to covary between adjacent time points. Additional details regarding CFA results are available from Clayton Neighbors on request. Table 1 presents

estimated means and standard errors for observed variables from the CFA. Table 2 presents estimated within-group effect sizes for each measure comparing changes from baseline to follow-up. Correlations among all factors are presented in Table 3. The correlations for the control group are presented above the diagonal. Correlations for the feedback group are presented below the diagonal.

Did the Intervention Reduce Drinking?

Intervention efficacy was assessed separately at 3 and 6 months by evaluating drinking reductions at each follow-up period as a function of the intervention (dummy coded) controlling for baseline drinking levels. In each analysis, a model constraining the feedback effect to zero was compared with a model in which the feedback effect was freely estimated. Consistent with the CFA, measurement errors for all four baseline drinking indicators were allowed to covary with their respective errors for follow-up indicators. Figure 1 (top) presents standardized coefficients for a model evaluating intervention effects on drinking at 3-month follow-up controlling for baseline differences. Measurement errors are not included in the figure for clarity. This model provided excellent fit and significantly improved fit compared with a model in which the feedback effect was constrained to zero, $\Delta\chi^2(1, N = 252) = 7.49, p < .01, \chi^2(22, N = 252) = 29.57, ns$, NFI = .99, CFI = 1.00, RMSEA = .037. The effect size for the intervention effect on drinking at 3-month follow-up was in the small-to-medium range, $B = -0.254, SE = 0.092, p < .01, d = .35$. Baseline drinking alone accounted for a very large proportion of variance in these data, $R^2 = .782$. Consequently, the unique proportion of variance accounted for by the intervention was relatively small, $\Delta R^2 = 1.30\%$. The intervention accounted for 5.55% of the variance that was not accounted for by baseline drinking. Figure 1 (bottom) presents standardized coefficients for a model evaluating intervention effects on drinking 6-month follow-up controlling for baseline differences. Results were essentially the same as the results at 3 months. Model fit was excellent, and improved fit compared with the model in which the feedback effect was constrained to zero, $\Delta\chi^2(1, N = 252) = 8.03, p < .01, \chi^2(22) = 31.56, ns$, NFI = .99, CFI = 1.00, RMSEA = .042. The magnitude of the intervention effect at 6 months was similar to the effect at 3 months, $B = -0.334, SE = 0.117, p < .01, d = .36$. Baseline drinking alone again accounted for a large proportion of variance in follow-up drinking $R^2 = .620$. The intervention uniquely accounted for 1.39% of the variance in 6-month drinking, corresponding to 3.66% of the variance not accounted for by baseline drinking. In sum, greater reductions in drinking behavior were evident among intervention participants relative to control participants at 3-month and 6-month follow-ups with effect sizes in the small-to-medium range.

Did the Intervention Impact Perceived Drinking Norms?

Evaluation of the effect of normative feedback on perceived norms followed the same approach as evaluation of normative feedback on drinking. The impact of the intervention on perceived norms was assessed separately at 3 and 6 months by evaluating changes in perceived norms at each follow-up period as a function of the intervention (dummy coded) controlling for baseline estimates of peer drinking. As before, in each analysis,

Table 1
Estimated Means and Standard Errors in the Confirmatory Factor Analysis

Variable	Control M	SE	Feedback M	SE
	T1 social reasons			
DMSOC	4.08	0.06	4.07	0.07
EXSOC	3.58	0.04	3.61	0.03
EVSOC	1.36	0.05	1.31	0.05
	T1 perceived norms			
PNWEEK	14.10	0.72	13.18	0.73
PNFREQ	4.15	0.08	3.98	0.07
PNOCC	2.85	0.07	2.83	0.09
	T2 perceived norms			
PNWEEK	12.25	0.63	8.74	0.48
PNFREQ	3.85	0.08	3.35	0.09
PNOCC	2.76	0.07	2.21	0.07
	T3 perceived norms			
PNWEEK	12.05	0.60	8.41	0.53
PNFREQ	3.92	0.08	3.32	0.08
PNOCC	2.66	0.09	2.26	0.08
	T1 drinking			
ACI	1.86	0.12	2.03	0.12
WEEK	10.91	0.85	12.14	0.82
PEAK	8.91	0.41	9.11	0.40
RAPI	7.29	0.67	7.22	0.56
	T2 drinking			
ACI	1.77	0.13	1.60	0.11
WEEK	9.45	0.81	8.73	0.70
PEAK	8.20	0.44	7.89	0.39
RAPI	6.50	0.56	5.65	0.53
	T3 drinking			
ACI	1.80	0.13	1.61	0.12
WEEK	10.01	0.84	8.53	0.78
PEAK	8.65	0.48	7.66	0.46
RAPI	6.45	0.68	5.74	0.64

Note. The loading for the first variable listed for each factor was fixed at 1 for model identification. T = Time; DMSOC = Social Rewards subscale of the Drinking Motives Questionnaire; EXSOC = social outcome expectancies; EVSOC = subjective evaluations of social effects of alcohol; PNWEEK = perceived number of drinks consumed per week by the typical student; PNFREQ = perceived frequency of consumption (per week) by the typical student; PNOCC = perceived number of drinks consumed per occasion by the typical student; ACI = Alcohol Consumption Inventory; WEEK = average number of drinks per week in the previous 3 months; PEAK = the maximum number of drinks consumed in one sitting in the previous month; RAPI = Rutgers Alcohol Problems Index.

Table 2
Within-Group Effect Sizes

Variable	Feedback 3-month	Feedback 6-month	Control 3-month	Control 6-month
		Drinking behavior		
ACI	.24	.22	.05	.03
WEEK	.28	.29	.11	.07
PEAK	.19	.21	.11	.04
RAPI	.18	.16	.08	.08
		Perceived norms		
PNWEEK	.46	.48	.17	.20
PNFREQ	.50	.56	.24	.17
PNOCC	.49	.42	.07	.15

Note. Effect sizes were calculated as the difference between the estimated mean at baseline and follow-up assessment divided by the estimated pooled standard deviation. ACI = Alcohol Consumption Inventory; WEEK = average number of drinks per week in the previous 3 months; PEAK = the maximum number of drinks consumed in one sitting in the previous month; RAPI = Rutgers Alcohol Problems Index; PNWEEK = perceived number of drinks consumed per week by the typical student; PNFREQ = perceived frequency of consumption (per week) by the typical student; PNOCC = perceived number of drinks consumed per occasion by the typical student.

a model constraining the feedback effect to zero was compared with a model in which the feedback effect was freely estimated. Consistent with the CFA, measurement errors for baseline indicators of perceived norms (PNFREQ and PNTYP) were allowed to covary with their respective errors for follow-up indicators. Figure 2 (top) presents standardized coefficients for a model evaluating intervention effects on perceived norms at 3-month follow-up. This model fit the data and significantly improved fit compared with a model in which the feedback effect was constrained to zero, $\Delta\chi^2(1, N = 252) = 19.67, p < .01, \chi^2(11) = 25.96, p < .01$, NFI = .99, CFI = 1.00, RMSEA = .074. The effect size for the intervention effect on drinking at 3-month follow-up was in the medium-to-large range, $B = -3.331, SE = .668, p < .01, d = .61$. Baseline social norms alone accounted for 32.80% of the variance in 3-month norms. The intervention uniquely accounted for 12.00% of the variance in 3-month norms, corresponding to 21.74% of the variance remaining after controlling for baseline norms.

Standardized coefficients for the model evaluating the impact of normative feedback on perceived norms at 6-month follow-up are

presented in Figure 2 (bottom). Results are essentially the same as the results at 3 months. This model fit the data very well and significantly improved fit over the model with the feedback effect constrained to zero, $\Delta\chi^2(1, N = 252) = 27.79, p < .01, \chi^2(11, N = 252) = 11.84, ns$, NFI = 1.00, CFI = 1.00, RMSEA = .017. The magnitude of the intervention effect at 6 months was again in the medium-to-large range, $B = -3.173, SE = .640, p < .01, d = .63$. Baseline social norms alone accounted for 25.90% of the variance in 6-month norms. The intervention uniquely accounted for 12.50% of the variance in 6-month norms, corresponding to 20.29% of the variance remaining after controlling for baseline norms. In sum, greater reductions in perceived norms were evident among intervention participants relative to control participants at 3- and 6-month follow-ups with effect sizes in the medium-to-large range.

Was the Intervention's Impact on Drinking Because of Changing Perceived Norms?

Evaluating change in perceived drinking norms as a mediator of the impact of the normative feedback intervention on alcohol consumption provides a test of the theoretical mechanism for the intervention. Normative feedback was expected to reduce overestimations of peer drinking. Reductions in overestimations of peer drinking were subsequently expected to reduce drinking. Following the assumed temporal sequence, we examined changes in perceived norms at 3 months as a mediator of the effect of normative feedback on drinking reductions at 6 months.

Mediation was evaluated using criteria described by Kenny and colleagues (Baron & Kenny, 1986; Kenny, Kashy, & Bolger, 1998). Briefly, support for mediation requires an effect of X (feedback) on Y (6-month drinking), X on M (3-month drinking), M predicts Y (controlling for X), and the impact of X on Y is no longer significant or substantially reduced when controlling for M. The effect of feedback on 6-month drinking was demonstrated above and presented in Figure 1 (bottom). The effect of feedback on 3-month norms was also demonstrated above and presented in Figure 2 (top). The third and fourth criteria were evaluated using SEM, in which 6-month drinking was simultaneously predicted from feedback and 3-month perceived norms (controlling for baseline levels of drinking and perceived norms). Measurement error covariances were modeled consistent with the CFA. This model provided good fit and demonstrated evidence for the remaining mediation criteria, $\chi^2(77, N = 252) = 134.74, p < .01$, NFI = .98, CFI = .99, RMSEA = .055. Specifically, 3-month norms were associated with drinking at 6-months, $B = .050, SE = .018, p <$

Table 3
Correlations Among Latent Variables in the Confirmatory Factor Analysis

Measure	1	2	3	4	5	6	7
1. T1 social reasons	—	.07	−.03	.06	.22*	.21†	.07
2. T1 perceived norms	.13	—	.60**	.66**	.41**	.26*	.27*
3. T2 perceived norms	−.08	.53**	—	.79**	.33**	.32**	.35**
4. T3 perceived norms	.18	.60**	.79**	—	.22†	.17	.30*
5. T1 drinking	.23*	.47**	.35**	.47**	—	.93**	.82**
6. T2 drinking	.08	.29**	.37**	.43**	.86**	—	.83**
7. T3 drinking	.14	.28*	.39**	.53**	.81**	.89**	—

Note. Correlations for the control group are above the diagonal. T = Time. Correlations for the normative feedback group are below the diagonal.
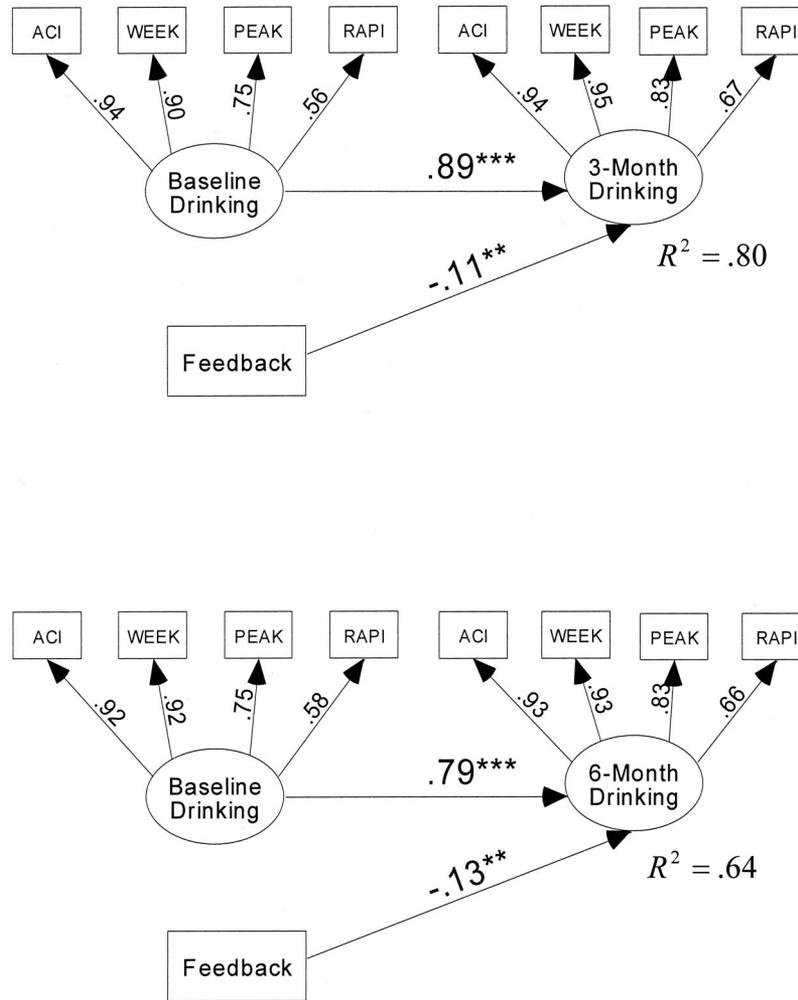† $p < .10$.   * $p < .05$.   ** $p < .01$.

Figure 1.   The effect of normative feedback on subsequent drinking behavior. ACI = Alcohol Consumption Inventory; WEEK = average number of drinks per week in the previous 3 months; PEAK = the maximum number of drinks consumed in one sitting in the previous month; RAPI = Rutgers Alcohol Problems Index. **$p < .01$, ***$p < .001$.

.01, $d = .35$, and the effect of feedback on 6-month drinking was no longer significant when controlling for 3-month norms, $B = -.174$, $SE = .131$, *ns*, $d = .17$.

Another way to evaluate mediation is by directly testing the mediation model where the effect of normative feedback on drinking reductions is constrained to occur only indirectly through changes in perceived norms at 3 months. In accordance, we tested a model in which the effect of feedback on drinking occurred only through changes in perceived norms at 3 months (Figure 3). Follow-up measures of perceived norms and drinking controlled for baseline differences in perceived norms and drinking, which were allowed to covary. Measurement error covariances were modeled consistent with the CFA and are excluded from the figure for clarity. This model constrained the direct path from normative feedback to 6-month drinking to zero and provided good fit, $\chi^2(77, N = 252) = 136.37$, $p < .01$, NFI = .98, CFI = .99, RMSEA = .055. It is important to note that freeing the constrained path between normative feedback and 6-month drinking did not result in better fit, $\Delta\chi^2(1, N = 252) = 1.63$, *ns*. In sum, these results provide strong support for changes in perceived norms as a mediator of the effects of normative feedback on reduced drinking behavior.

Did Intervention Efficacy Differ as a Function of Drinking for Social Reasons?

Multigroup SEM was used to evaluate whether the intervention was more effective among individuals who drank more for social reasons at 3 and 6 months. First, drinking at 3 months was examined as a function of baseline social reasons controlling for baseline drinking. Measurement errors for all four baseline drinking indicators were allowed to covary with their respective errors. Social reasons for drinking were specified as a latent variable consisting of social drinking motives, social alcohol expectancies, and subjective evaluations of social alcohol effects. A baseline model was fit in which all parameters were constrained to equality across both intervention and control groups, $\chi^2(115, N = 252) = 162.37$, $p < .01$, NFI = .97, CFI = .99, RMSEA = .041. Moderation was tested by comparing this model with a second
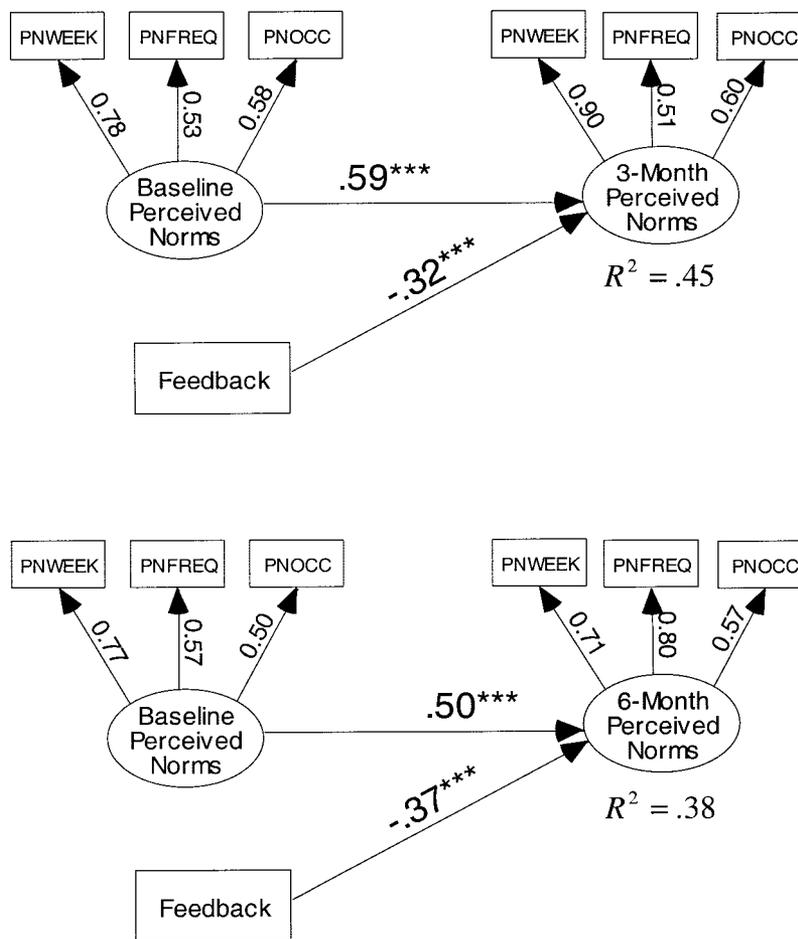
Figure 2. The effect of normative feedback on subsequent perceived norms. PNWEEK = perceived number of drinks consumed per week by the typical student; PNFREQ = perceived frequency of consumption (per week) by the typical student; PNOCC = perceived number of drinks consumed per occasion by the typical student. ***$p < .001$.

model in which the path from baseline social reasons to 3-month drinking was freed to vary across groups. The unconstrained model improved fit, $\Delta\chi^2(1, N = 252) = 6.18$, $p = .01$, $\chi^2(114, N = 252) = 156.19$, $p < .01$, NFI = .98, CFI = .99, RMSEA = .038, providing empirical support for social reasons as a moderator of intervention efficacy. As expected, in the control group, social reasons were not associated with changes in drinking at 3-month follow-up, $B = .333$, $SE = .247$, *ns*, $d = .17$. In the normative feedback condition, however, participants who drank more for social reasons reported greater drinking reductions at 3-month follow-up, $B = -.528$, $SE = .241$, $p < .05$, $d = .28$. The model in which the relationship between social reasons for drinking and follow-up drinking was constrained to be equal across groups accounted for 78.10% of the variance in follow-up drinking. The model in which the relationship between social reasons for drinking and follow-up drinking was free to vary across groups uniquely accounted for an additional 1.70% of the variance in follow-up drinking. Figure 4 presents standardized coefficients for 3-month drinking as a function of baseline social reasons for drinking, controlling for baseline drinking for the control group (top) and the intervention group (bottom). Measurement errors are again excluded for clarity.

The same approach was used to examine whether group differences in consumption at 6 months were more strongly related to baseline social reasons for drinking in the intervention group versus the control group. The baseline model in which all parameters were constrained to equality across groups again provided good fit, $\chi^2(115, N = 252) = 165.49$, $p < .01$, NFI = .97, CFI = .99, RMSEA = .042. This model accounted for 78.10% of the variance in 6-month drinking. The unconstrained model, allowing the path from social reasons to 6-month drinking to vary across groups, did not improve fit, $\Delta\chi^2(1, N = 252) = .13$, *ns*. Further examination revealed that social reasons were not associated with changes in drinking at 6 months for either group. Thus, the intervention appeared to be somewhat more effective for those who were motivated to drink for social reasons initially, but this effect was no longer evident at 6 months.

Discussion

Previous researchers have suggested that correcting overestimated drinking norms should reduce drinking (Baer et al., 1991; Prentice & Miller, 1993). Personalized normative feedback designed to correct normative misperceptions has been included as a component in a
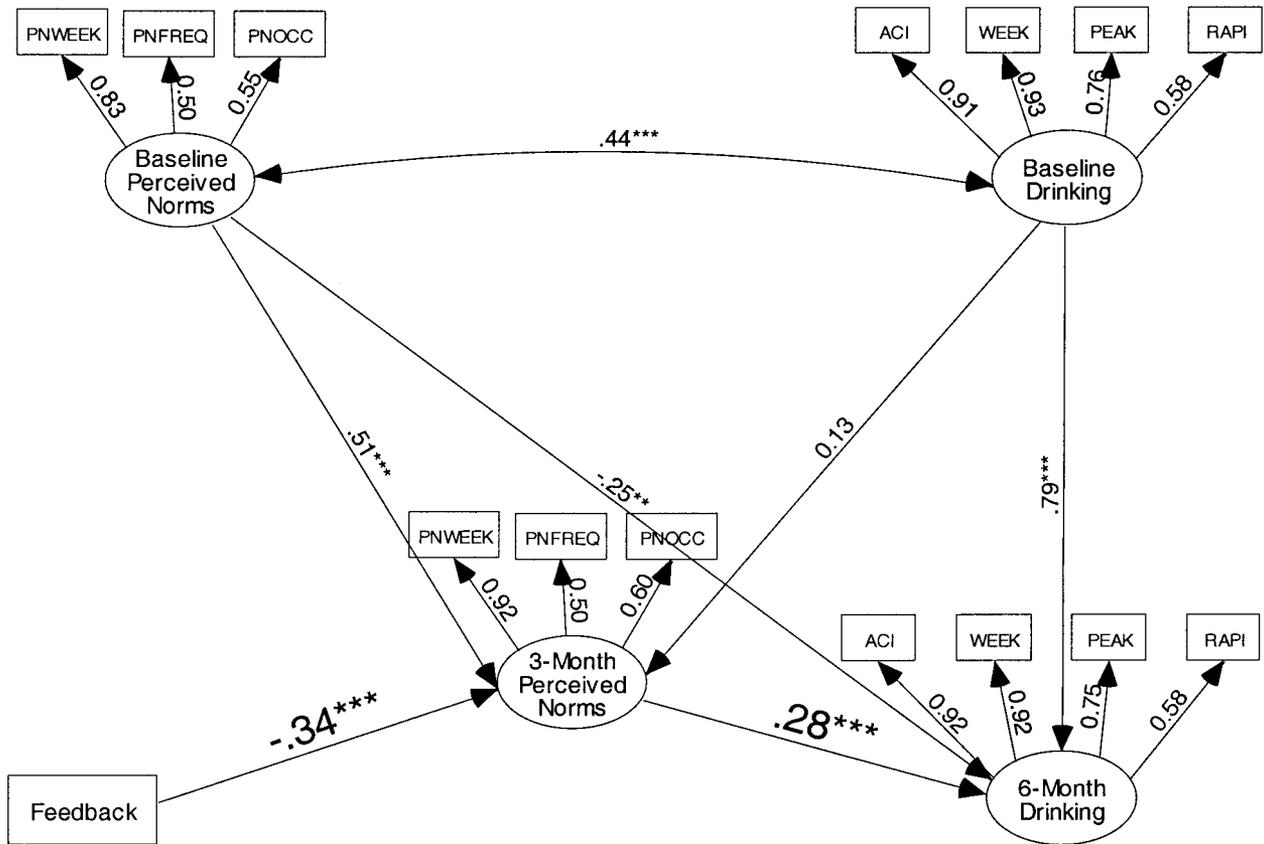
Figure 3. Changes in perceived norms as mediator of intervention efficacy. PNWEEK = perceived number of drinks consumed per week by the typical student; PNFREQ = perceived frequency of consumption (per week) by the typical student; PNOCC = perceived number of drinks consumed per occasion by the typical student; ACI = Alcohol Consumption Inventory; WEEK = average number of drinks per week in the previous 3 months; PEAK = the maximum number of drinks consumed in one sitting in the previous month; RAPI = Rutgers Alcohol Problems Index. **$p < .01$, ***$p < .001$.

number of brief interventions that have demonstrated efficacy in reducing reported consumption. However, no published research to date has effectively evaluated the unique impact of personalized normative feedback in reducing alcohol consumption. The present research demonstrated that personalized normative feedback alone is sufficient to measurably reduce drinking behavior among heavy-drinking college students for up to 6 months. The intervention had relatively small effects on drinking at 3- and 6-month follow-ups and medium effects on misperceptions in drinking norms at both 3- and 6-month follow-up sessions. In this study, most of the variance in follow-up drinking was accounted for by baseline drinking. The relatively small effect sizes associated with reported behavior change may be due in part to the consistency of drinking behavior over short time intervals (Sher, Wood, Wood, & Raskin, 1996). Consistent with previous research (S. E. Collins et al., 2002), results also revealed that the changes in perceived norms were responsible for reduced drinking behavior among intervention participants, providing additional support for the theoretical basis of the intervention. Our results also demonstrate that social norms interventions may be somewhat more effective among students who are largely motivated to drink for social reasons.

College drinking prevention approaches using normative feedback vary widely on a number of important dimensions, making compar-

ison between studies extremely difficult. These dimensions include, among other factors, method of delivery (social marketing, mailed feedback, individual interview, group format, and computer), intervention target (all students, heavy drinkers, athletes, freshmen, and students in fraternities or sororities), type of norms (injunctive or descriptive), normative referent, length of follow-up, duration of intervention, and number and type of other components included in the intervention. Given the broad heterogeneity of the literature, it is not surprising that findings have been mixed: Some studies have found no effects on changing norms or reducing drinking, other studies have found weak effects, whereas others have found relatively large effects. Studies most comparable with the computerized normative feedback intervention presented in this study are those that use mailed feedback, given that they involve no interpersonal interaction with intervention targets. Two of these studies reported medium-to-large effects (.68–1.01) of mailed feedback on drinking at 6 weeks postintervention (Agostinelli et al., 1995; Walters, 2000) but did not include longer follow-up assessments. A third study reported smaller effects (.28–.33) at 6 weeks but also included a 6-month follow-up at which differences between the feedback and attention control group were no longer evident (S. E. Collins et al., 2002). All three of these studies included more extensive feedback and nonnormative information (e.g., risk information, BAC information, family history, alcohol
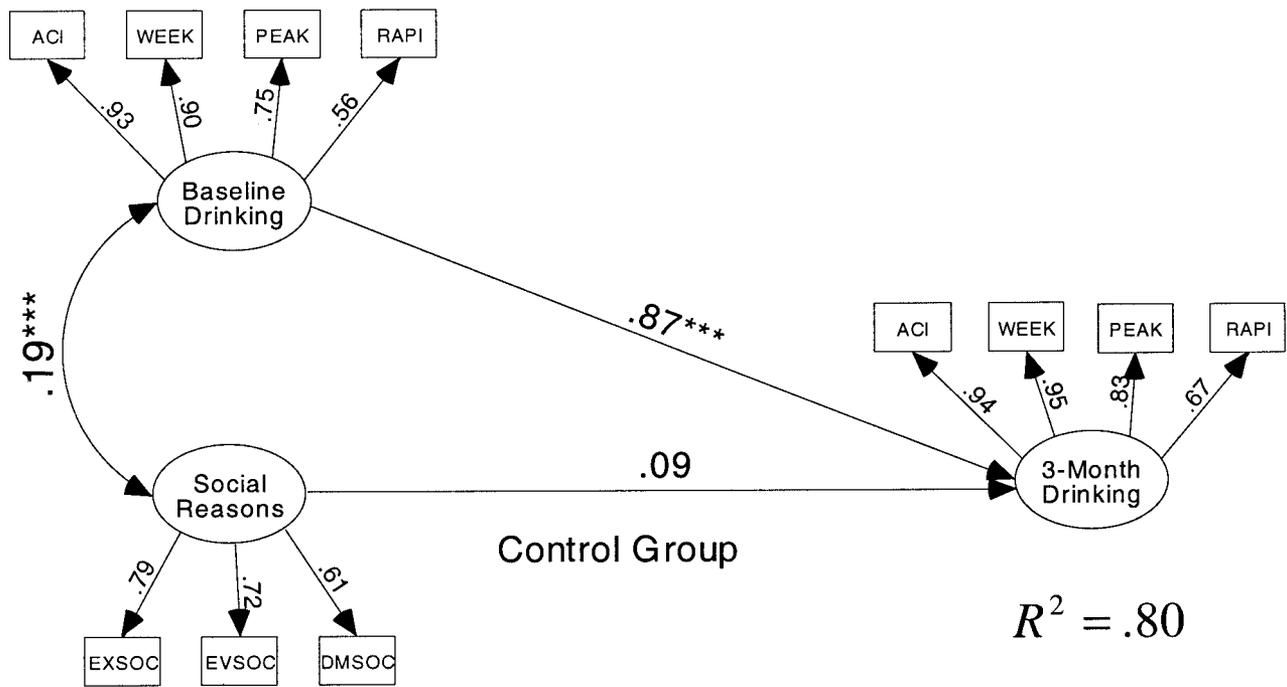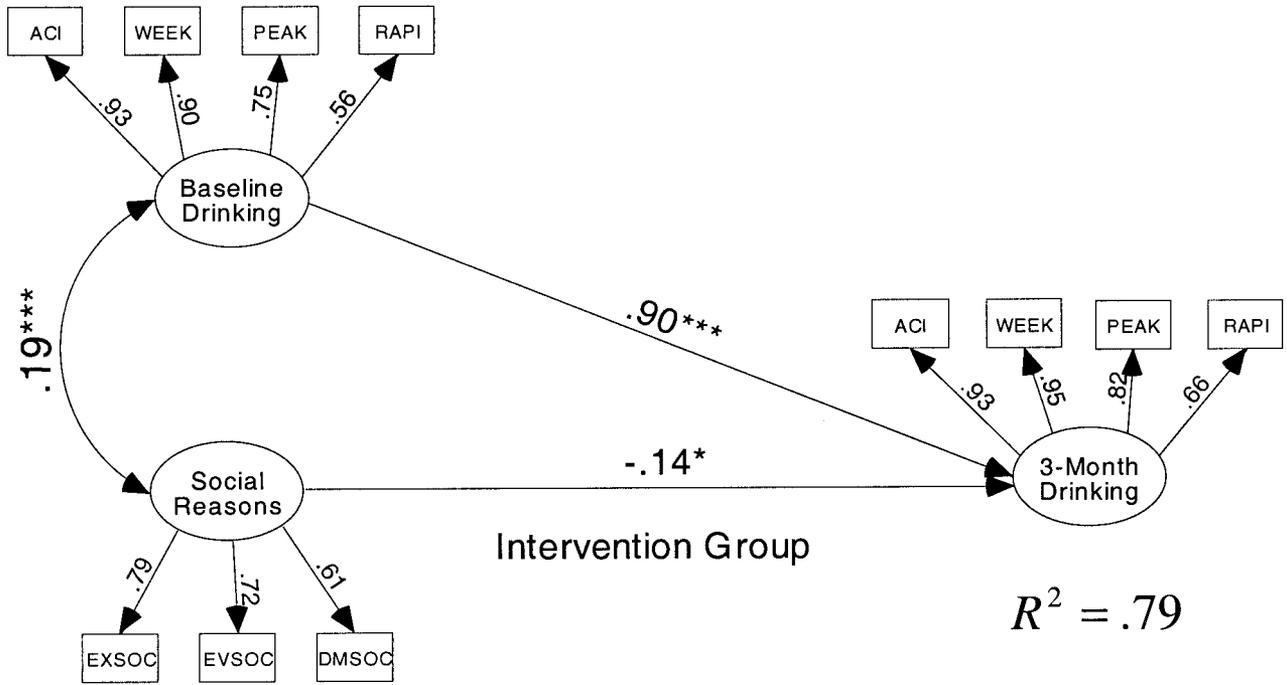
Figure 4. Social reasons for drinking as moderator of intervention efficacy. ACI = Alcohol Consumption Inventory; WEEK = average number of drinks per week in the previous 3 months; PEAK = the maximum number of drinks consumed in one sitting in the previous month; RAPI = Rutgers Alcohol Problems Index; EXSOC = social outcome expectancies; EVSOC = subjective evaluations of social effects of alcohol; DMSOC = Social Rewards subscale of the Drinking Motives Questionnaire. *p < .05, ***p < .001.

expense, and didactic material). Because we did not include a 6-week posttest in the present study, it is impossible to know whether our participants reduced their drinking more immediately following the intervention than at 3- and 6-month follow-up. Given the previous research and the present findings, we suspect that normative components of noninteractive feedback interventions are largely responsible for intervention effects. We speculate that on average, normative feedback all by itself (mailed or computer delivered) probably accounts for immediate effects on drinking behavior in the small-to-medium range and accounts for small but reliable effects for a more extended period of time (e.g., 3–6 months).

The intervention in this study was modeled after the normative component of the BASICS intervention (Dimeff et al., 1999). The BASICS intervention consists of a 1-hr interview session in which students are provided feedback information about their alcohol use and consequences, graphic normative feedback similar to that used in this study, review of risk factors, review of expectancies, accurate information regarding alcohol effects, and moderation tips. Previous evaluations of the BASICS and similar interventions have, on average, demonstrated medium effects on drinking behavior and smaller effects on alcohol-related consequences for up to 2 years (Borsari & Carey, 2000; Larimer et al., 2001; Marlatt et al., 1998; Murphy et al., 2001). The present findings suggest that the normative feedback component is clearly one of the active components in this intervention but not the only one. Additional work is needed to evaluate the unique contributions of other specific components in this intervention.

Limitations

The present research was limited in a number of ways. One limitation of this research may be the generalizablity of the sample, which was composed of undergraduate psychology students. Although this is of some concern, previous research using brief interventions has found effects using the same population on other campuses (Agostinelli et al., 1995; Walters, 2000). Previous research has demonstrated that there are ethnic differences in alcohol use and alcohol-related problems (Keefe & Newcomb, 1996); consequently, results from this sample may differ somewhat on campuses with different ethnic compositions. An additional limitation is that all of the drinking outcome measures were self-reported. Although the accuracy of self-reported drinking and other drug use has been the subject of debate, there is good evidence supporting the reliability and validity of self-report measures among college students and adolescents (Johnston & O'Malley, 1985; Johnston, O'Malley, & Bachman, 2001). The reliability and validity of self-reports is comparable and not systematically biased relative to collateral reports (Marlatt et al., 1998) and can be maximized by assurances of confidentiality, standardized measures, and inclusion of multiple measures of key constructs (Babor, Stephens, & Marlatt, 1987), all of which were present in this research. Another limitation regarding the sample is that nonheavy drinkers were not evaluated in this study; thus, this intervention can only be recommended for students who drink above the norm. In addition, the lack of a more immediate follow-up assessment limited our ability to make inferences about the immediate impact of the intervention and to comparisons with other similar interventions. Finally, the current research did not include an attention-placebo control condition; thus, it is not completely possible to conclude that the intervention itself, rather than

additional attention, accounted for the observed effects. Although this is a limitation, previous research has found little to no effect of a variety of educational or attention-placebo interventions on drinking behavior in similar research (Larimer & Cronce, 2002), and because of the brevity of the current intervention, the difference in time in the protocol between intervention and control participants was negligible. In addition, results of mediating analyses provide support for the theoretical model underlying the intervention, an effect unlikely to result simply from additional time or attention.

Future Directions

Empirical research evaluating social norms prevention approaches is rapidly expanding. At this point we can say with some confidence that these approaches work, and we have a pretty good idea of why they work. There are several avenues that clearly need to be explored before more specific conclusions can be drawn. For example, are some methods of delivering normative feedback more effective than other methods, and if so, is there a direct relationship between cost and effort required to deliver and complete the interventions and effect size? Who are the best targets for normative interventions and which normative referents should be used in presenting feedback? How does injunctive feedback compare with descriptive feedback in normative information? Results from a recent meta-analysis (Borsari & Carey, 2003) revealed several factors that moderate normative misperceptions, on which normative feedback interventions are based, and provide some direction in addressing these questions. An additional direction for future research concerns the extent to which feedback recipients process the information. No attempt was made in this study to evaluate students' reactions to the feedback. It is likely that the extent of processing and the degree to which students accept or discount the information medites its ability to change perceptions. Finally, studies comparing normative feedback to other intervention components will help us separate wheat from chaff in multicomponent interventions. Some of these questions are already beginning to be addressed by prevention researchers but others remain completely unexplored.

Conclusions

Brief interventions aimed at reducing problem drinking among college students have shown considerable promise (Larimer & Cronce, 2002). The present research reveals that normative feedback is an important element of brief interventions and provides important empirical justification for its inclusion. It also provides some support for the notion that students who drink for social reasons are better targets for social norms interventions. In isolation, personalized normative feedback is effective in correcting normative misperceptions and, to some degree, reducing drinking among heavy drinkers. The effect sizes for personalized normative feedback alone are smaller than some more intensive interventions involving interpersonal interaction and multiple components. However, the potential for disseminating computerized personalized normative feedback to thousands of students at relatively low-cost and minimal effort via the Internet amplifies the relatively small effect sizes.

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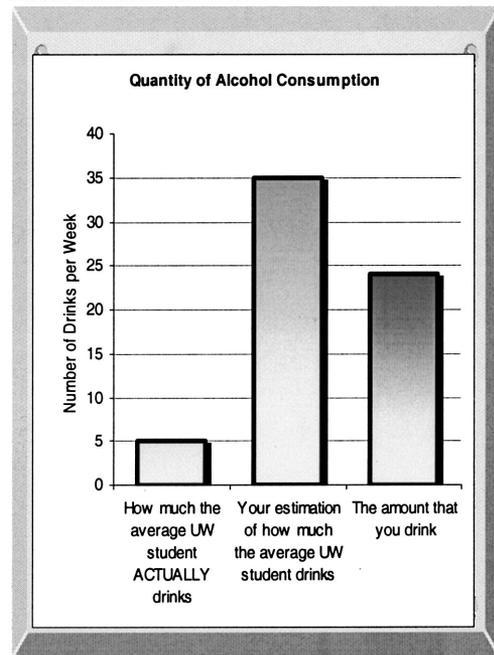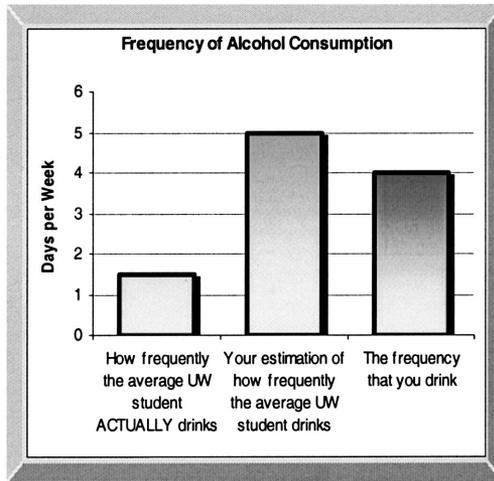
Appendix

Sample Feedback for the Personalized Normative Feedback Intervention

According to the information you provided us during the computer assessment, the number of occasions you drank (frequency) was 4 times a week. The average amount you drank on each occasion (quantity) was 6 drinks.

You completed questions asking you what you believed the average frequency and quantity of alcohol consumed by other college students. You told us that you believed that the average student drank 5 times a week and during each occasion, s/he consumed 7 drinks.

The actual drinking norm for students at the University of Washington is 1.5 times a week drinking about 3.5 drinks on each occasion.

Your percentile rank (comparing you to other college students) is 91%, which suggests that you drink more than 91% of other college students.

Frequency of Alcohol Consumption

Days per Week

- How frequently the average UW student ACTUALLY drinks
- Your estimation of how frequently the average UW student drinks
- The frequency that you drink

Quantity of Alcohol Consumption

Number of Drinks per Week

- How much the average UW student ACTUALLY drinks
- Your estimation of how much the average UW student drinks
- The amount that you drink