

Dismantling Motivational Interviewing and Feedback for College Drinkers: A Randomized Clinical Trial

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Motivational interviewing (MI) is a counseling style that has been shown to reduce heavy drinking among college students. To date, all studies of MI among college students have used a format that includes a feedback profile delivered in an MI style. This study was a dismantling trial of MI and feedback among heavy-drinking college students. After an initial screen, 279 heavy-drinking students were randomized to (a) Web feedback only, (b) a single MI session without feedback, (c) a single MI session with feedback, or (d) assessment only. At 6 months, MI with feedback significantly reduced drinking, as compared with assessment only (effect size = .54), MI without feedback (effect size = .63), and feedback alone (effect size = .48). Neither MI alone nor feedback alone differed from assessment only. Neither sex, race or ethnicity, nor baseline severity of drinking moderated the effect of the intervention. Norm perceptions mediated the effect of the intervention on drinking. MI with feedback appears to be a robust intervention for reducing drinking and may be mediated by changes in normative perceptions.

Keywords: motivational interviewing, feedback, college student, alcohol

Because of its widespread nature and serious consequences, reducing drinking among college students has become a major health objective in the United States (U.S. Department of Health and Human Services, 2000). In national surveys, approximately 80–85% of U.S. college students report consuming alcohol during the previous year (Johnston, O'Malley, Bachman, & Schulenberg, 2007; O'Malley & Johnston, 2002), and 40–45% report a heavy-drinking episode during the 2-week period prior to completing the survey (Johnston et al., 2007; O'Malley & Johnston, 2002; Wechsler, Lee, Kuo, et al., 2002). Students who engage in heavy drinking are more likely than other students to experience a variety of problems. These problems include driving while under the influence, trouble with campus police, low academic performance, engaging in unprotected or unplanned sexual activity, sexual assault, injury, and even death (Engs, Diebold, & Hanson, 1996; Hingson, Heeren, Winter, & Wechsler, 2005; Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). In addition, the consequences of heavy drinking spread beyond the individual student.

Non-heavy-drinking students living on campuses with high rates of heavy drinking compared with students residing on campuses with lower rates of heavy drinking are at greater risk of experiencing physical and sexual assault, property damage, and disruption of sleep or study (Wechsler, Moeykens, Davenport, Castillo, & Hansen et al., 1995), whereas residents of the surrounding neighborhoods report more negative secondhand effects such as noise, litter, vandalism, and public intoxication (Wechsler, Lee, Hall, Wagenaar, & Lee, 2002) than do residents who live near campuses with lower rates of heavy drinking.

Motivational interviewing with feedback (MIF) is one individual-level intervention that has garnered substantial support for reducing drinking among college students (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Larimer & Cronce, 2007; National Institute on Alcohol Abuse and Alcoholism, 2002). MIF can be conceptualized as two intertwined components: (a) motivational interviewing (MI) and (b) personalized drinking feedback. MI is a directive, client-centered counseling style for eliciting behavior change by helping clients to explore and resolve ambivalence (Miller & Rollnick, 2002). The feedback component includes the presentation of information on personal drinking patterns, comparisons of the student's drinking patterns to U.S. adult and college drinking norms, risk factors for heavy drinking, and negative consequences experienced as a result of heavy drinking.

There is also a small body of literature that suggests feedback alone may reduce drinking among college students (Agostinelli, Brown, & Miller, 1995; S. E. Collins, Carey, & Sliwinski, 2002; Larimer et al., 2007; Neighbors, Larimer, & Lewis, 2004; Walters, 2000; Walters, Bennett, & Miller, 2000; Walters, Vader, & Harris, 2007). In fact, two recent reviews have concluded that stand-alone

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feedback (e.g., available on the Web or mailed) may be as effective as in-person feedback among heavy-drinking college students, at least in the short term (Walters & Neighbors, 2005; White, 2006). The efficacy of stand-alone feedback interventions raises a basic question about the incremental value of the MI component in MIF interventions. Specifically, does MIF have an effect over feedback alone, delivered without personal contact? The question is of practical importance, because of the expense involved in training and supervising providers, concerns about student interest in seeking in-person help for drinking, and the time involved in administering in-person interventions (Larimer & Crouce, 2007; Walters & Neighbors, 2005).

The empirical literature comparing MIF and feedback-only interventions is sparse. One study found equivalent reductions in drinking after receiving feedback with or without an individual MI (Murphy et al., 2004), whereas another study found a long-term advantage for MIF compared with written feedback alone (White, Mun, Pugh, & Morgan, 2007). In addition, because MI interventions uniformly contain feedback, it is unclear whether MI alone (without the presence of a feedback profile) might be sufficient to reduce drinking. One small study (Juarez, Walters, Daugherty, & Radi, 2006) found that women reduced their drinking 8 weeks after receiving feedback, whether it was delivered by mail or via an in-person MI session, but an MI session that did not include feedback had no effect.

The present study was designed to dismantle MI and feedback, allowing us to test three questions simultaneously. First, we were interested in which intervention format(s) would lead to greater reductions in drinking compared with the assessment only (AO) intervention. This basic question adds to the knowledge of effective strategies for reducing college drinking. Second, we were interested in whether an in-person intervention (MIF) would have an effect over feedback that was delivered without human contact. As previously mentioned, this question is important because of the additional cost involved with an in-person intervention. Third, we were interested in whether the inclusion of feedback would improve the effectiveness of MI. This question is important because it may reveal something about the mechanism of change in MI and feedback interventions, which, to date, few studies have addressed. An alternative way of thinking about the second and third questions is to ask whether there is a synergistic effect of MI and feedback. In other words, is the combined effect of MI and feedback greater than the effects of MI alone and of feedback alone?

Two possible mechanisms of effect were examined: changes in perceived drinking norms and an increase in the use of protective drinking strategies. Of the five studies that have reported mediation analyses (one MIF study and four stand-alone feedback studies), three found support for changing normative perceptions (Borsari & Carey, 2000; Neighbors et al., 2004; Walters et al., 2007) and one found support for protective behaviors (Larimer et al., 2007) as a mediator of the intervention effect. Finally, consistent with previous work (Lewis, Neighbors, Oster-Aaland, Kirkeby, & Larimer, 2007; Neighbors & Larimer, 2002; Walters et al., 2007), we examined sex, race and ethnicity, drinking severity, and readiness to change as potential moderators. Moderator effects have been inconsistent in previous research, and thus no hypotheses were offered.

Method

Participants and Recruitment

Participants were recruited from a medium-size private university in the southern United States during the fall of 2006 and spring of 2007. Participants were at least 18 years old and reported at least one heavy-drinking episode (i.e., five or more drinks for men, four or more drinks for women, in a single episode) in the past 2 weeks. Participants were recruited using a variety of methods, including invitation e-mails to undergraduate psychology classes, brief presentations in undergraduate psychology and health courses, and flyers posted on campus. Approximately 1,500 students were informed about the opportunity, leaving approximately 675 potentially eligible to participate in the study (assuming a 45% binge-drinking rate). A power analysis indicated that 55 participants per condition would be sufficient to detect an effect size of .50 (Raudenbush & Liu, 2000, 2001). For their participation, students could receive \$20 or psychology course extra credit at each assessment and for attending the in-person session (if so assigned). The project was approved by the institutional review boards of both the University of Texas Health Science Center at Houston and the university from which the study participants were recruited.

A total of 279 students qualified for the study and agreed to participate. (An additional group of 75 students was recruited as part of a separate study question not addressed in this article.) The sample was 64.2% female, 84.6% White, with a mean age of 19.8 years. Freshman made up 41.2% of the sample, sophomores were 21.1%, juniors were 21.9%, and seniors were 15.8%. Most students reported living in dorms or residence halls on campus (45.9%) or in off-campus housing (37.6%).

Randomization, stratified by sex and heavy-drinking frequency (i.e., one heavy episode in the past 2 weeks vs. more than one heavy episode), was completed automatically after the students entered their screening data. Participants then received an e-mail directing them to the online consent and baseline assessment battery. The four study conditions were (a) a personalized feedback report displayed on the screen (FBO; $n = 67$), (b) a single session of MI without a personalized feedback report (MIO; $n = 70$), (c) a single session of MI with a personalized feedback report (MIF; $n = 73$), or (d) AO ($n = 69$). Participants and counselors were not blind to the group assignment. Figure 1 shows the flow of participants through the project.

Measures

Measures were completed online at a baseline assessment, as well as at 3- and 6-month follow-up assessments. Outcome measures included alcohol consumption and alcohol-related problems; potential mediators included normative perceptions and protective behaviors; potential moderators included readiness to change, drinking severity, and demographic variables.

Alcohol consumption was assessed using a 7-day drinking calendar modified from the Daily Drinking Questionnaire (R. L. Collins, Parks, & Marlatt, 1985). Participants were asked to think about a typical week in the past month and, for each day, to estimate how many drinks they typically consumed on that day. To calculate peak blood alcohol concentration (BAC), we also asked participants to report the number of standard drinks consumed and the duration of their heaviest drinking episode in the past month.

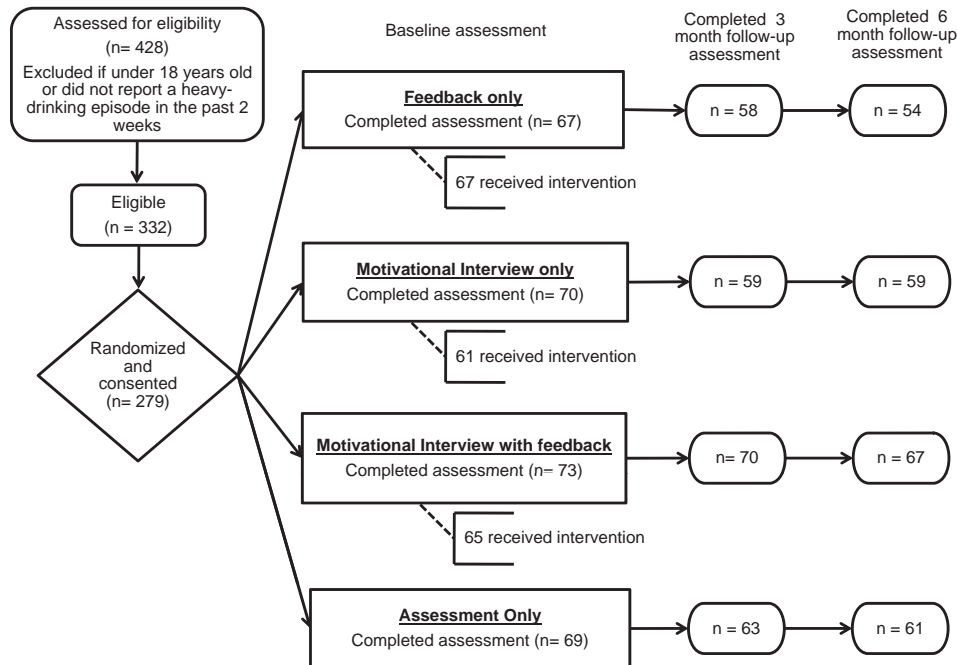


Figure 1. Flow of participants.

We used this information, along with sex and weight, to calculate an estimated peak BAC.

Alcohol-related problems in the past 3 months were measured by the 23-item Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989). The RAPI has been shown to have good reliability among college students (Borsari & Carey, 2000; Neal & Carey, 2004). Reliability in the present study was $\alpha = .87$ for the total scale.

Normative drinking perceptions were measured by asking students to estimate the percentage of U.S. college students of their sex who drank more than they did. Norm discrepancy was determined by subtracting participants' estimates of what percentage of students drank more than them from the percentage of students who actually drank more than them (based on national surveys).

Protective behaviors in the past 3 months were assessed by the 15-item Protective Behavioral Strategies Survey (PBSS; Martens et al., 2005). The PBSS asks respondents to identify different protective behaviors they might have used in the last 3 months while they were drinking. Reliability in the present study was $\alpha = .86$ for the total scale.

Readiness to change was measured using the 12-item Readiness to Change Questionnaire (RTCQ; Rollnick, Heather, Gold, & Hall, 1992). The RTCQ contains three 4-item scales that assess levels of precontemplation, contemplation, and action. The RTCQ has demonstrated adequate reliability and validity (Carey, Purnine, Maisto, & Carey, 1999; Heather, Rollnick, & Bell, 1993), although some have presented important limitations of existing measures of readiness to change among college students (Carey & Hester, 2005). Reliability in the present study was $\alpha = .64$, $.79$, and $.80$ for the precontemplation, contemplation, and action subscales, respectively, and $\alpha = .86$ for the total scale.

Drinking severity was measured using the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, Dela-

fuate, & Grant, 1993). This test has shown adequate reliability and validity among college drinkers (Fleming, Barry, & Macdonald, 1991; Kokotailo et al., 2004; O'Hare & Sherrer, 1999).

Demographics included sex, age, year in school, race or ethnicity, athletic participation, fraternity or sorority membership, dating status (i.e., single, committed relationship, engaged or married), and residential status (i.e., on campus, off campus with friends, off campus with parents).

Intervention Procedures

Feedback. The personalized feedback was modified from the electronic Check-Up to Go (e-CHUG; <http://www.e-chug.com>), a commercially available feedback program. The feedback used the information from a participant's assessment and included (a) a quantity and frequency summary of drinking behavior (e.g., standard drinks consumed in the last 30 days, estimated peak BAC, caloric intake), (b) comparison to U.S. adult and campus norms, (c) level of risk (e.g., AUDIT score, tolerance, estimated genetic risk), (d) estimated dollar amount and percentage of income spent on alcohol, and (e) local referral resources. For those students in the FBO condition, the feedback form was displayed immediately on the computer screen after the participant completed the baseline assessment. Those in the MIF condition received their feedback profile during the MI session.

In-person sessions. The in-person sessions were delivered by two doctoral-level counselors and five clinical psychology doctoral students. Each counselor completed 40 hours of MI training (including lecture, role play, and practice) and submitted four practice tapes prior to seeing participants. To ensure fidelity, we had counselors complete a checklist for each session and all sessions were videotaped for weekly supervision. Providers delivered both kinds of sessions (i.e., MIO and MIF).

The MIO sessions followed the stylistic elements discussed in Miller and Rollnick (2002). Using the format outlined in Walters and Baer (2006), we arranged for sessions to include the following elements: (a) orienting the participant to the session and the limits of confidentiality; (b) exploring the participant's drinking, including peak episodes and related problems; (c) discussing ambivalence around drinking; (d) using readiness rulers to elicit importance and confidence language; (e) discussing change in the hypothetical or concrete; and, if appropriate, (f) developing a plan for change. The counselor also provided the participant with a list of campus and community resources related to alcohol.

The MIF sessions were designed to be identical to the MIO sessions, with the exception of the additional personalized feedback profile. The feedback form used in the MIF sessions was identical to that used in the FBO condition. Participants in the MIF group were given a copy of their personal feedback report and a list of community resources related to alcohol.

To ensure fidelity, we had a random subset of videotaped sessions (30 MIF and 30 MIO) coded by two independent coders using the Motivational Interviewing Treatment Integrity Code 3.0 (MITI; Moyers, Martin, Manuel, & Miller, 2003). Sixteen tapes were double coded and intraclass correlation coefficients were calculated to measure interrater reliability. The intraclass correlation coefficients for the MITI counselor global scores were all in the *fair* category (evocation = 0.48, collaboration = 0.47, autonomy/support = 0.45, direction = 0.45, empathy = 0.59, and global MI spirit = 0.58; Cicchetti, 1994). The mean MITI counselor global scores for evocation, collaboration, autonomy/support, direction, empathy, and global MI spirit were at or above a beginning proficiency level. As a conservative test, separate *t* tests were computed on each of the five MITI counselor global scores. Results indicated no statistically significant differences between the two conditions on any of these scores (all *ps* > .05).

Ninety percent of participants completed the 3-month follow-up and 86% completed the 6-month follow-up. Participants were not more likely to drop out of the study at either follow-up on the basis of baseline characteristics or study condition. There were no adverse events or side effects reported in any of the intervention groups.

Preliminary Analyses and Data Analysis Strategy

The correlations at baseline between the three outcome measures were drinks per week and peak BAC, .597; drinks per week and alcohol-related problems, .484; peak BAC and alcohol-related problems, .433. Because of concern about overlapping content between the three outcome measures, we used principal component analysis to create a composite drinking variable. At baseline, a first component accounted for 67% of the variance, reflecting roughly equal contributions from each of the three standardized drinking measures. This first component was used as the composite measure of drinking outcome. To preserve comparability of the composite measure over time, the coefficients from the baseline analysis were applied to the unstandardized measures at each follow-up assessment. Therefore, the composite measure at baseline is a standard score (with mean 0 and standard deviation 1) and is expressed in the same units at the 3-month and 6-month follow-ups.

The effects of the interventions on the composite drinking variable were analyzed using a mixed linear model, a type of multilevel model that allows for the use of partial data from subjects who did not participate in both follow-ups. Subject was a random effect, the intervention conditions were fixed between-subject effects, and time (baseline and the two follow-ups) was the within-subject effect. To address the questions described in the introduction, we compared conditions on the composite drinking measure. When differences between conditions emerged on this measure, comparisons were then made on each of the three specific outcome measures (drinks per week, peak BAC, and alcohol-related problems). All tests were conducted at the .05 significance level.

Preliminary analyses showed significant quadratic components of some time paths; therefore, time was analyzed as a categorical variable, represented by dummy variables for the two follow-up times. Effects of intervention on the outcomes, adjusted for their baseline levels, appeared as Time \times Intervention interactions. To test for the synergistic effect of MI and FB, we parameterized the interventions via factorial structure, crossing MI and FB and testing for an interaction effect. In the mixed linear model, this interaction appeared as a MI \times FB \times Time interaction.

We assessed norm discrepancies and protective behaviors as potential mediators, following the procedures described by Baron and Kenney (1986): (a) We used regression to determine whether the intervention significantly affected the composite drinking measure; (b) we regressed the possible mediators on intervention to determine whether the intervention affected either or both of them; (c) in regressions of the composite drinking measure on the intervention and one potential mediator, we tested whether the latter affected the outcome while holding intervention constant; and (d) in the same regressions as in Step 3, we assessed change in the strength of the effect of intervention on the outcome compared with the regression in Step 1, that is, whether the mediator accounted for some or all of the effect of the intervention.

Sex, race or ethnicity, readiness to change, and drinking severity were tested as potential moderators. Each hypothesized moderator was tested by including a Moderator \times Intervention Condition interaction in the previous analyses.

Results

At baseline, the 279 participants reported consuming an average of 15.5 standard drinks per week, with a mean peak BAC of 0.165% in the past month. There were no significant differences between the groups in terms of sex, race or ethnicity, drinks per week, peak BAC, negative consequences, the composite drinking measure, or protective behaviors (bivariate associations of each variable with intervention group, Pearson chi-square for sex and race or ethnicity, one-way analysis of variance for other measures, all *ps* > .10). The MIO sessions had a mean length of 40 minutes and the MIF sessions had a mean length of 50 minutes. Counselors varied significantly in their mean session length, $F(1, 6) = 3.087, p = .008$, but neither counselor assignment nor session length predicted changes in client drinking when holding intervention group constant. Table 1 shows the mean drinks per week, peak BAC, and alcohol-related problems at baseline, 3 months, and 6 months.

Table 1
 Mean Drinks per Week, Peak Blood Alcohol Concentration (BAC), and Alcohol-Related Problems by Condition at Baseline, 3 Months, and 6 Months

Condition	Baseline			3 months			6 months		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
	Composite								
FBO	67	-0.141	0.966	57	-0.392	0.857	54	-0.486	0.907
MIO	70	-0.046	0.911	59	-0.263	0.897	59	-0.298	1.045
MIF	73	0.170	1.068	70	-0.345	0.880	66	-0.551	0.745
AO	69	0.004	1.039	62	-0.348	0.938	60	-0.247	1.056
	Drinks per week								
FBO	67	14.27	11.59	58	13.48	14.67	54	12.07	12.31
MIO	70	14.29	9.98	59	13.17	13.33	59	11.59	9.55
MIF	73	17.81	14.38	70	11.69	12.70	67	10.19	8.71
AO	69	15.28	12.89	63	11.97	11.80	61	12.92	14.16
	Peak BAC								
FBO	67	0.147	0.088	58	0.125	0.096	54	0.116	0.095
MIO	70	0.164	0.090	59	0.142	0.086	59	0.140	0.110
MIF	73	0.182	0.097	70	0.132	0.087	67	0.112	0.088
AO	69	0.167	0.102	63	0.130	0.103	61	0.135	0.104
	Alcohol-related problems								
FBO	67	5.99	6.01	57	4.84	4.67	54	3.72	4.70
MIO	70	6.37	6.50	59	4.97	4.70	59	5.41	7.28
MIF	73	6.67	6.92	70	5.20	5.35	66	4.06	4.96
AO	69	6.38	6.35	63	5.10	5.09	61	5.77	6.11

Note. FBO = feedback only; MIO = motivational interviewing only; MIF = motivational interviewing with feedback; AO = assessment only.

Efficacy of the Intervention Conditions

All analyses were conducted using an intent-to-treat model. Thus, participants who completed the baseline assessment and were assigned to one of the in-person interventions (MIO or MIF) but who did not attend the in-person session were included in the analyses.

Comparisons of the three interventions with AO (the first basic question) are shown in Table 2. Relative to AO, the MIF intervention significantly affected changes in the composite measure from baseline to 6 months, $t(275) = -3.28, p = .001$, effect size = 0.54. This difference was also significant for each of the three outcomes. In terms of the magnitude of differences at the 6-month follow-up, participants in the MIF group reported consuming 5.26 fewer drinks per week than participants in the AO group, $t(275) = -2.63, p = .01$, effect size of 0.41, when adjusting for baseline levels. Participants in the MIF group reported a peak BAC that was 0.039% less than that of participants in the AO group, $t(275) = -2.32, p = .02$, effect size = 0.37, when adjusting for baseline levels. Finally, participants in the MIF group reported a mean alcohol problem score that was 2.32 points lower than the mean score of participants in the AO group, $t(275) = -2.35, p = .02$, effect size = 0.43, when adjusting for baseline levels. Neither MIO nor FBO differed from AO.

Comparisons of MIF with FBO (the second basic question) are shown in Table 3. MIF lowered the composite measure significantly more than FBO did at both 3 months and 6 months, relative to baseline. Follow-up tests indicated a similar finding for drinks per week at 3 months and 6 months and for peak BAC at 6 months.

The final question concerned the additional contribution of feedback to an MI intervention. MIF was significantly more effi-

cient than MIO at both 3 months and 6 months for the composite measure. Follow-up tests indicated a similar pattern of results for drinks per week and peak BAC at 3 and 6 months and for alcohol-related problems at 6 months (see Table 3).

An additional way to test for differences between groups is in terms of an interaction effect. Using a factorial structure involving main effects for FB and MI and their interaction, the interaction effect was significant for the composite measure at both 3 months, $t(275) = -2.14, p = .03$, effect size = $-.52$, and 6 months, $t(275) = -2.07, p = .04$, effect size = $-.57$. The interactions were also significant for drinks per week at both 3 months, $t(275) = -3.09, p = .002$, effect size = $-.75$, and 6 months, $t(275) = -2.11, p = .04$, effect size = $-.60$, and for peak BAC at 6 months, $t(275) = -2.11, p = .04$, effect size = $-.50$. This suggests a synergistic effect of MIF, where its effect was greater than the sum of the effects of feedback alone and of MI alone.

The primary analyses were repeated, adjusting for the following baseline covariates: sex, frequency of binge drinking in the 2 weeks prior to baseline, race or ethnicity (non-White vs. White), weight, year in school, place of residence, participation in sports, smoking status, relationship status, and drinking severity. Adding the covariates did not change the pattern of results.

Mediators and Moderators of Intervention Efficacy

Following the procedures described by Baron and Kenny (1986), we found that (a) the MIF intervention significantly affected the composite drinking measure; (b) the intervention reduced norm discrepancies at 6 months by 17%, with the MIF group becoming more

Table 2
Effects of FBO, MIO, and MIF Versus AO on Drinking Behavior

Intervention comparison	Baseline vs. 3 months				Baseline vs. 6 months			
	Estimate	SE	<i>p</i>	Effect size	Estimate	SE	<i>p</i>	Effect size
Composite								
FBO vs. AO	0.049	0.134	.71	0.043	-0.086	0.156	.58	-0.093
MIO vs. AO	0.131	0.133	.33	0.186	0.044	0.153	.77	0.075
MIF vs. AO	-0.219	0.128	.089	-0.307	-0.488	0.149	.001	-0.535
Drinks per week								
FBO vs. AO	1.49	1.71	.39	0.134	0.53	2.09	.80	0.076
MIO vs. AO	2.60	1.70	.13	0.308	0.32	2.05	.88	0.096
MIF vs. AO	-3.28	1.64	.046	-0.351	-5.26	2.00	.009	-0.412
Peak BAC								
FBO vs. AO	0.009	0.016	.58	0.082	0.003	0.018	.88	-0.021
MIO vs. AO	0.011	0.015	.47	0.132	0.010	0.017	.57	0.101
MIF vs. AO	-0.019	0.015	.21	-0.211	-0.039	0.017	.021	-0.374
Alcohol-related problems								
FBO vs. AO	-0.17	0.93	0.85	-0.111	-1.78	1.03	0.086	-0.341
MIO vs. AO	-0.16	0.92	0.86	-0.052	-0.32	1.01	0.76	-0.052
MIF vs. AO	-0.45	0.89	0.62	-0.135	-2.32	0.99	0.020	-0.428

Note. FBO = feedback only; MIO = motivational interviewing only; MIF = motivational interviewing with feedback; AO = assessment only.

accurate in their norm estimates (i.e., smaller discrepancies; $p < .001$); (c) lower norm discrepancies were associated with lower composite scores ($p = .006$); and (d) adjusting for norm discrepancies reduced the magnitude of the intervention effect by 45% on the composite measure. The pattern of results was significant for peak BAC. Adjusting for norm discrepancies reduced the magnitude of the intervention on peak BAC by 79%. Protective behavior, which was

only weakly related to the intervention and to the outcomes, did not mediate the intervention effect.

Sex, race or ethnicity, readiness to change, and drinking severity were tested as potential moderators of the intervention effect on drinking at 6 months by adding interaction effects to the model. Results showed no moderation effects for sex, race or ethnicity, readiness to change, or AUDIT score on any of the drinking variables (all $ps > .05$).

Table 3
Effects of MIO and FBO Versus MIF on Drinking Behavior

Intervention comparison	Baseline vs. 3 months				Baseline vs. 6 months			
	Estimate	SE	<i>p</i>	Effect size	Estimate	SE	<i>p</i>	Effect size
Composite								
MIF vs. FBO	-0.268	0.131	.041	-0.329	-0.402	0.153	.009	-0.477
MIF vs. MIO	-0.350	0.129	.007	-0.433	-0.533	0.150	.000	-0.626
Drinks per week								
MIF vs. FBO	-4.77	1.67	.0046	-0.430	-5.79	2.05	.0050	-0.472
MIF vs. MIO	-5.88	1.66	.0005	-0.583	-5.58	2.01	.0058	-0.523
Peak BAC								
MIF vs. FBO	-0.027	0.015	.074	-0.298	-0.041	0.017	.017	-0.391
MIF vs. MIO	-0.030	0.015	.049	-0.336	-0.049	0.017	.0043	-0.508
Alcohol-related problems								
MIF vs. FBO	-0.27	0.91	.76	-0.030	-0.54	1.02	.59	-0.163
MIF vs. MIO	-0.29	0.90	.75	-0.076	-2.01	1.00	.045	-0.352

Note. FBO = feedback only; MIO = motivational interviewing only; MIF = motivational interviewing with feedback.

Discussion

MIF has been found to reduce drinking in college student populations. However, the separate and collective effects of MI and feedback have not been previously examined in large clinical trials. This study was designed to answer three questions: whether any intervention would show a greater reduction in drinking than the AO intervention, whether an in-person feedback intervention would reduce drinking over a feedback intervention delivered without human contact, and whether MI's effectiveness would be enhanced through the inclusion of a feedback profile. With regard to the first question, we found that at 6 months, MIF reduced drinking to a greater degree than AO. The other intervention formats (MIO and FBO) did not show an effect over AO. With regard to our second question, we found that at 6 months, MIF reduced drinking over FBO. With regard to our third question, we found that at 6 months, MIF reduced drinking over MIO. The effects were consistent for the composite drinking measure and drinks per week and mostly consistent for peak BAC. The results for alcohol-related problems were weaker and more inconsistent.

Norm perceptions mediated the effect of the intervention, with participants in the MIF condition becoming more accurate in their normative drinking estimates and changes in norm perceptions being linked to changes in drinking behavior. In contrast to a previous study (Larimer et al., 2007), we did not find that protective behaviors mediated the intervention effect. However, our interventions did not specifically target protective behaviors, which may limit the usefulness of this finding. In addition, we did not find that sex, race or ethnicity, readiness to change, or baseline drinking severity moderated the effect of the intervention. The present study was strengthened by the use of a randomized prospective design, well-validated measures, a rigorous training and supervision sequence, and two commercially available intervention formats. Our 6-month retention rate (86%) was excellent relative to similar studies (Lewis et al., 2007; Neighbors & Larimer, 2002; Walters et al., 2007; White et al., 2007).

Our findings must also be viewed in light of several study limitations. First, our sample contained a disproportionate number of female and White students, although our study population did reflect roughly the composition of the institution. This may limit the generalizability of our findings to other kinds of students or other institutions. Second, we relied on self-report outcome data, although we followed procedures that minimized the chance of biased reporting, including using well-validated measures and offering assurances of confidentiality. Research suggests that self-reports are generally more valid under these conditions (Williams, Aitken, & Malin, 1985; Wolber, Carne, & Alexander, 1990). Third, our present results cannot account for the effect of the assessment on drinking. A number of researchers have speculated that assessment interviews can contribute to clinical outcomes (Clifford & Maisto, 2000; Kypri, Langley, Saunders, & Cashell-Smith, 2007; Ogborne & Annis, 1988; Project MATCH Research Group, 1998; L. C. Sobell & Sobell, 1981; M. B. Sobell, Brochu, Sobell, Roy, & Stephens, 1987), although only a handful of studies have experimentally tested this hypothesis. There were also limitations related to our choice of intervention formats. For instance, the MIO and MIF conditions varied in contact time because of the addition of the feedback component. Although this project approximated a dismantling study, we did not use a true dismantling

design for practical reasons. For instance, the feedback format varied (i.e., online vs. face-to-face), and we did not include a condition that received face-to-face feedback without the MI segment of the session. Our selection of experimental conditions was based on feasibility concerns, as well as how MI and feedback interventions are typically used in practice. Because our FBO condition was delivered on the Internet, we were also not able to verify whether students, in fact, read their feedback profiles.

Despite these limitations, our results have three main implications. First, our finding about the effectiveness of the typical MI format (MIF) supports the existing literature on the effectiveness of this intervention. Our study also suggests that the inclusion of both an in-person MI session and a feedback profile is more potent than either feedback alone or MI alone in this population. In fact, our findings suggest that MI and feedback have a synergistic effect when used together. The effect size of the MIF-AO contrast was similar to those reported in other brief interventions for college drinkers (for a review, see Carey, Scott-Sheldon, et al., 2007). In practical terms, the 50-min MIF intervention reduced 6-month drinking and drinking-related problems by nearly 30%, when compared with AO. The generalizability of our findings is strengthened by the use of a commercially available feedback (<http://www.e-chug.com>) and published intervention protocol (Walters & Baer, 2006).

Second, our findings on the lack of effectiveness of stand-alone feedback help to qualify previous research. Although several studies have found that mailed or Web-based feedback can effectively reduce drinking, most have been limited to a relatively small sample and short follow-up (Walters & Neighbors, 2005). Studies that follow students out to 6 or 12 months have reported mixed results, with some showing an effect (Larimer et al., 2007; Neighbors & Larimer, 2002) and others not showing an effect (S. E. Collins et al., 2002). Studies that have used multiple assessment windows often find that the effect of feedback fades in the long term. For instance, Collins, Carey, and Sliwinski (2002) reported reductions in drinking at 6 weeks as a result of receiving mailed feedback, although the differences were no longer present at 6 months. Likewise, Walters et al. (2007) found that Web feedback reduced drinking over control at 8 weeks, but the differences between groups were no longer evident at 16 weeks. Thus, it is possible that our first follow-up assessment (3 months) missed any short-term effect that the feedback might have had.

Finally, our mediator and moderator findings are mostly consistent with previous research. Change in perceived norms has been the most consistent mediator of MI and feedback interventions (Borsari & Carey, 2000; Neighbors et al., 2004; Walters & Neighbors, 2005). This is congruent with the body of research that suggests that college drinkers tend to overestimate how much others are drinking (Borsari & Carey, 2001) and misperceive the prevailing norms toward drinking and drunkenness (Perkins & Berkowitz, 1986). In this study, the average baseline student estimated that he or she was at the 57th percentile of U.S. college students, when he or she was actually at the 83rd percentile. Arnett (2000) described a period of "emerging adulthood" when young people strongly rely on the behavior of their peers to judge whether their own behavior is acceptable. Thus, it makes sense that changing normative perceptions might be a strong motivator to make changes in drinking. However, it is also important to note that both the FBO and the MIF conditions contained identical feedback

information. The fact that norm perceptions mediated the effects of MIF on drinking behavior but FBO failed to have an effect on drinking behavior may suggest that the MI portion of the interview helps to amplify the effect of the feedback, perhaps by eliciting verbal commitments to change on the basis of the discrepancy of the normative information. Absent a provider, it might be possible to increase the salience of the normative information, for instance, by having students participate in an interactive feedback program or actually calculate their own feedback.

Past studies have reported inconsistent moderator findings. With few exceptions, outcomes have been similar across sex, family history of alcohol abuse, fraternity or sorority membership, participation in sports, and motivation to change (S. E. Collins et al., 2002; Marlatt et al., 1998; Murphy et al., 2004; Walters et al., 2007). Larimer et al. (2007) found that neither sex nor drinking severity moderated the effect of a feedback intervention, although a more conservative analysis suggested that women benefited more from the intervention. There is also evidence that MI and feedback interventions may be more effective among heavy drinkers (Murphy et al., 2001) and those who drink for social reasons (Neighbors et al., 2004). In both cases, it would seem to make sense that normative information might have a greater effect on those who are more interested in social comparison or those who are heavier drinkers (and hence have a more extreme profile). However, another study (Carey, Henson, Carey, & Maisto, 2007) found that strength of social comparison predicted changes even in the absence of an intervention. Contrary to expectations, students who used social cues to guide their behavior maintained or even increased their consumption, relative to other students.

It is curious that we found a stronger intervention effect for MIF at 6 months than at 3 months. It is possible that our findings were influenced by the semester variation in drinking that is typical of college drinkers (Del Boca, Darkes, Greenbaum, & Goldman, 2004). Because two thirds of the students in our sample were recruited in the fall, the 3-month follow-up was more likely to occur in January or February (a lower and potentially more homogenous drinking period), whereas the 6-month follow-up was more likely to occur during April or May (a higher and potentially more heterogeneous drinking period that includes spring break). Similarly, although we did not find significant differences between groups at baseline, it is still possible that the MIF group, which scored generally higher than the other groups on baseline drinking measures, had the most room to decrease.

Given the body of evidence in support of MI and other feedback-based interventions, future researchers might consider ways to best disseminate such findings. Although the present study suggests one intervention format, other models may be better suited to how interventions are conducted in practice. Most intervention studies have used a format similar to ours; however, a 45-min counseling intervention may still be too awkward and lengthy for other contexts in which heavy-drinking students are typically encountered (e.g., judicial settings, residence life, student health). In fact, far less research has been done on brief interventions delivered by nonspecialists, even though the bulk of interactions around alcohol may happen outside of formal alcohol treatment contexts. Our study suggests that one direction for such efforts might be the inclusion of feedback in brief interventions. The feedback portion of our MIF sessions typically lasted 10–15 min, but because of the presence of additional MI components, it

is unclear specifically what the contribution of the feedback is to the overall session. One way the feedback contribution might be better clarified is through an analysis of in-session client language, specifically, the extent to which feedback changes the nature of client speech and how in-session speech is related to treatment outcome. In an analysis of session tapes from Project MATCH, Moyers et al. (2007) found that MI-consistent therapist behaviors were more likely to be followed by client talk in support of change, whereas MI-inconsistent therapist behaviors were more likely to be followed by client talk in support of the status quo. However, beyond this general support for MI practice, there is little information on the extent to which feedback might be able to elicit interest or readiness to change. Further research on therapeutic mechanisms of change may help to identify more efficient ways of conducting treatment interactions.

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